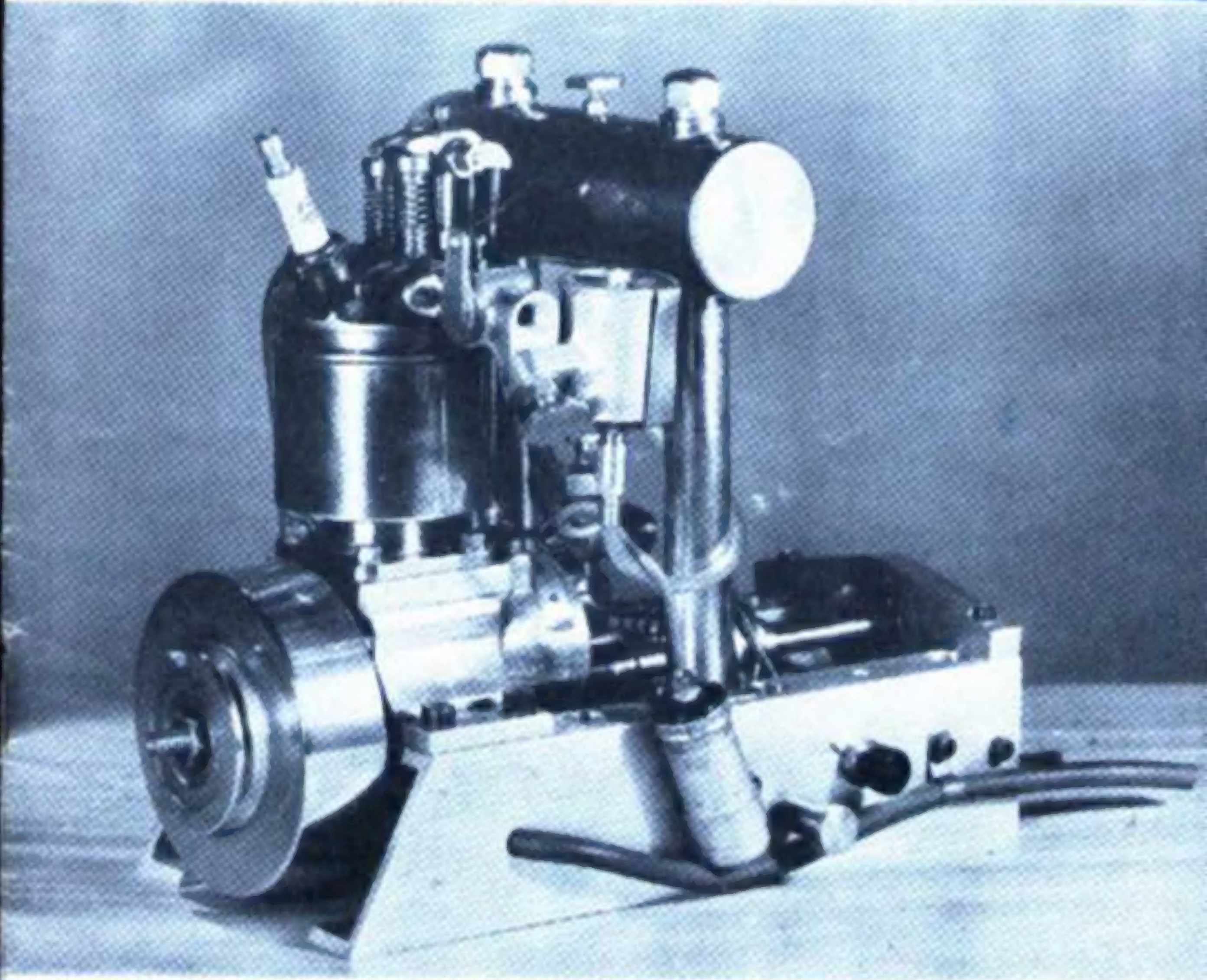
THE MODEL ENGINEER



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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

Of the many designs for model petrol engines which have been published in *The Model Engineer* in the past, few have been more popular than the 15 c.c. o.h.v. four-stroke engine known as the "Kiwi," and although the description of this engine appeared as far back as 1935, the design is by no means out of date. It has been equally successful as a racing engine, and for more modest duties in prototype model power boats, its flexibility and smooth running being important assets for the latter work. Our illustration shows a recently-constructed example of this engine, by Mr. F. J. Wood, a description of which appears in this issue. It has been adapted for water cooling, by the fitting of a jacket around the cylinder barrel, and also modified in minor details. Despite the attractions of the modern types of i.c. engines, which are available ready made, and run on special fuels, with glow plug or compression-ignition, there is much to be said in favour of the more orthodox type of petrol engine, which is equally interesting in construction and subsequent running.

SMOKE RINGS

The N.A.M.E. Exhibition

WE WOULD remind our readers that the Corn Exchange, Hanging Ditch, Manchester, will be a focal point for everyone who can get there during the five days from the 20th till the 25th of this month. The exhibition organised by the Northern Association of Model Engineers is the reason and should not be missed, as it is one of the most important and extensive of its kind.

With the Clubs

WE WOULD like to call the attention of hon. secretaries to the fact that we occasionally make use of photographs for illustrating our "With the Clubs" columns, and we are prepared to consider any photographs sent in for this purpose, but subject to the following requirements: The prints should be clear and sharp, printed on glossy paper; preferably, they should not be less than ¼-plate size (3¼ in. by 4¼ in.).

The subjects should be either models of any sort, built by members of the clubs concerned, or of some "newsy" item of interest. The more photographs we receive, the more we can use; but they should be of really good quality and likely to interest a large number of readers. All photographs published will be paid for at our usual rates for reproduction fees.

"Opening Day" at Thames Ditton

THE MALDEN Society of Model Engineers usually sets aside the first Sunday in the month as a track day at the track at Thames Ditton, during the season. This year, Easter Sunday, April 5th, will mark the opening of the season, but with a little more than the usual significance; for the society's new headquarters building has been completed and will be open for inspection by visitors.

A cordial invitation is extended to owners of 2½-in., 3½-in. or 5-in. gauge locomotives to attend the opening day, and if the weather should be adverse, nobody need get wet now that the society has, so to speak, its own roof over its head!

Another Centenary Express

TO MARK the centenary of the opening of Doncaster plant in 1853, a special train will be run on Sunday, September 20th, 1953, from King's Cross to Doncaster and back, similar to the G.N.R. Centenaries Express in 1952. The train will be hauled to Doncaster by Ivatt Atlantics Nos. 990 and 251, in G.N.R. livery, running double-headed, and in the reverse direction by a Class A4 Pacific. The "Flying Scotsman" buffet-lounge car will be included in the train formation. As the sponsors of the trip have had to undertake to cover the cost of preparing the locomotives, including the removal of No. 990 from the York Museum and its replacement afterwards, the cost of tickets has been fixed at 55s., inclusive of meals at every seat on both outward and return journeys, and the guide fee for the tour of the plant at Doncaster.

For the benefit of railway enthusiasts in the North, a second trip will be run from Leeds to King's Cross and back on the following Sunday, hauled in the up direction by the Atlantics and returning behind a Class A4 Pacific. This trip will also include a visit to the Doncaster plant. Owing to the longer journey, it is expected that the fare for this trip will be £3.

Provisional reservations and further information may be had from: Mr. L. J. W. Smith, 898A, High Road, Finchley, N.12., Mr. H. T. S. Bailey, 80, Bessborough Place, S.W.1 (for September 20th trip), or Mr. A. F. Pegler, "White Lodge," Rampton, nr. Retford, Notts. (for September 27th trip).

Model Power Boat News

BY MERIDIAN

STARTING THE ENGINE

THE spectacle of a competitor trying desperately to start a refractory engine is a fairly common one at almost any regatta. In recent years, the advent of the glow-plug has made starting up a comparatively easy task, but even now some difficulty seems to be experienced by some competitors with both the racing and steering types of i.c. engined boats. The notes and comments that I have to offer on this subject are based on personal experience and observation over a considerable period at many regattas.

The ability to start the engine easily and rapidly is obviously a desirable quality, especially so in a competition, where a run may be lost if the boat is not started up within a given time limit. There have been many races that have been won and lost solely on starting ability, where the "old reliable" has had the advantage of the potentially faster boat.

Spark Ignition

There are still many engines using spark ignition—especially among the steering boats, so let us consider some of the snags involved with the common coil and battery system.

In pre-war days I can recollect speed-boat exponents taking anything up to twenty minutes on the line trying to start, with hardly a pop from the engine as a reward. Now, I think that this sort of thing is usually due to feeble ignition. Where the spark is weak it will not fire the rich mixtures necessary for starting a cold engine. Actually, a really healthy spark will widen the mixture range surprisingly; this can be demonstrated by running a model engine on a full-size coil and battery set-up.

Where magnetos have been used, starting troubles have been generally less marked, and certain boats so fitted were noteworthy for easy starting. With the ultra-lightweight type of magneto, it may be of help to boost the primary with an external battery when starting—especially where the mag. is not being rotated very fast; for example, if driven from the camshaft of a four-stroke engine.

The root cause of poor coil ignition is trying to get a quart out of a pint pot. Usually, accumulators are small, and the coils not efficient enough; under dry conditions they work reasonably well, but the circumstances usually obtaining in boats are not at all good. Splashing from the propeller is almost inevitable and it is amazing how water creeps inside the hull after a run.

It is a good investment to seal the coil in some non-conductive material, so that if the boat should capsize no harm is done. I would suggest that a box made of Perspex would meet the case. This material is easily worked, and has a high insulation value. It may be joined very easily with chloroform, which is by far the best medium for the job.

Even steering boats may be swamped on occasion, when stopping or by hitting the bank, so precautions should also be taken to protect the coil in this type of craft.

It is a great pity that at present it does not seem possible to obtain a coil that is really robust and efficient enough for speed-boat work. Nowadays, manufacturers of coils concentrate on light weight, with a view to use in model aircraft and cars. It is true that under dry conditions, the light weight coil will work well, especially with engines of 10 c.c. or less. They even work with *dry batteries*, a thing you cannot get away with in model power boats.

Where the larger engines up to 30 c.c. are concerned, good ignition equipment is an essential. Most of the present users of coil ignition in boats are using coils of pre-war manufacture, or modifield full size equipment; for example, a stripped-down magneto armature.

Very few power boat men make their own coils, although it can be done if the right methods are used. Most people take the view, however, that it is quite enough to deal with the engine and hull—not to mention the various other accessories. The work involved in the making of coils is tedious, although it may be facilitated by various set-ups that convert the lathe into a coil winding machine.

Some years ago I used a home-made coil with a 30 c.c. engine with fair success. This particular coil was never intended for this work at all, but was an experimental Ruhmkorff coil made by a relative. It weighed 13 oz., and was pile wound, with no interleaving, but when winding, the stock spool was immersed in molten paraffin wax, so that the wire was evenly coated as it was wound on to the coil. It should be mentioned that this old coil was left for years in a damp cupboard, and when retrieved, the external connections had been almost corroded away. When cleaned up, it worked very well, giving an excellent spark with a small 4 V accumulator.

It has always surprised me that external booster batteries have not been used more often as a starting aid. After all, the glow-plug merchants cheerfully take large accumulators out to the line when starting, and the little batteries used in model power boats are very heavily loaded and require all the amps they possess for running, let alone lengthy starting attempts.

These small accumulators are quite a problem, as here one is up against the weight question again. A 4 V lead-acid battery of only 3 A-hours weighs 1 lb. 10 oz. With steering boats, extra weight is not so important if it means a good spark, but even so, it is advisable to keep the total weight within reasonable limits, if only for reasons of transport.

Very careful charging and maintenance is necessary in order to get the best from small accumulators. It pays to make up a small charger and do the job at home, rather than leave it to the tender mercies of the local radio shop. The maker's instructions should be followed implicitly when charging, the cells kept clean, and the acid s.g. kept to the correct value. With new batteries, it is a good thing to assist the plates to

Mr. Ward, of the Orpington Club (right), starting his " A " class boat

technique is usual, it can still be uncertain.

The great thing is to work to a set routine every time. Most engines have their own peculiarities, and the method for one engine may differ slightly from another—the best method must be found by trial and error.

One advantage with glow-plugs is that an abnormally rich mixture can be ignited. Most engines will start readily using the following procedure: Choke carburettor, pull over several turns, unchoke, apply battery leads, pull over. The engine should start within a few pulls.

This very simple routine may be upset if, for example, not enough neat fuel has been drawn up, or the plug element is not hot enough. I am convinced that these two possibilities alone are responsible for most of the starting troubles that may be experienced with this type of ignition.

Even if an over-rich mixture is present, it will fire after a short session of belt-pulling, provided the plug element is glowing well.

In cold weather, starting is always a little more uncertain, and I offer the following possible explanations to account for this fact :

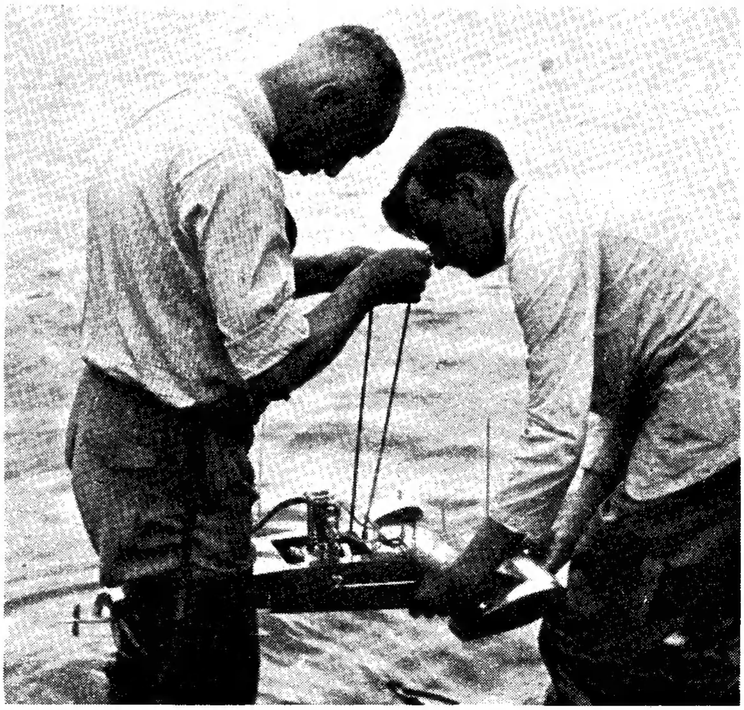
form by gently charging and discharging several times before being put to serious use.

I have not had much experience with small alkaline cells, but I understand that the electrolyte should be checked, and if necessary renewed at fairly frequent intervals for best results. This is probably due to the very small amount of liquid present in the cells.

Another important factor for easy starting is, of course, the right carburettor setting. This applies to all types of i.c. engines, whatever sort of ignition is used. It is not good practice to twiddle the jet needle in order to get a rich mixture, as it is so easy to forget how many turns have been made, and attempt to start on a setting upon which the engine cannot normally run. It is best to leave the needle on or near its normal running position, and enrich the mixture by choking the air intake alone.

Mr. R. E. Mitchell, in a recent article, has pointed out the effect of the viscosity of different fuel-oil mixtures, and there is no doubt that accurate measuring will help to keep the jet setting constant.

It should not be difficult to start up when using glow-plug ignition in conjunction with methanol—castor-oil base fuels, but if a hit-and-miss



Mr. Churcher, of the Coventry Club (left) starting his " B " class boat " Annette "

According to the text books, alcohol-air mixtures will not explode at temperatures below 20 deg. C. approx. (68 degrees F.). Thus if the air temperature is low, the engine compression must be relied upon to raise the heat of the mixture to combustion temperature. Should the engine have poor compression, or large piston clearances when cold, it may be impossible to obtain enough compression without the aid of extraordinarily rich mixtures to help seal the leaks. In turn, this mixture is too wet, even for a glow-plug ! Alcohol also has a large cooling effect on evaporation, and it is significant that Continental motor vehicles designed for using alcohol, have special carburettors with " hot spots " or other devices to warm up the incoming mixture.

The accumulator supplying the glow-plug when starting, may also be at fault in cold weather. The capacity of an accumulator is *nil* at the freezing point of the electrolyte, and varies accordingly with temperature. (This is one of the reasons why the car will not start on a cold winter's morning !)

The battery lead usually favoured by power boat men is fairly light twin flex, the resistance of which is high enough to drop the voltage a little when a heavy current is passed. As a matter of interest, I conducted a simple test, using a sensitive Avometer and a standard make of glow-plug. The lead was twin flex 14/36, and 4 ft. 6 in. in length.

Without the glow-plug in circuit the voltage at the plug end of the lead was 2.1 volts. Putting the plug in circuit reduced this to 1.7 volts. The current taken was exactly 3 amps.

Under normal conditions, this voltage drop is all to the good since the recommended voltage for most glow-plugs is 1½ or not more than 2. However, when low temperature reduces the activity of the accumulator, the lead resistance may be too great, and it may help considerably if a heavier one is used. The heavy lead must not be used in warmer weather, or the result will be many burnt out glow-plugs.

On some boats, the glow-plug is wired to a socket, in which is plugged the battery lead throughout the starting procedure. In my view, this practice shortens the life of the plug and may tend to flatten the battery. I suggest that a switch could be used in conjunction with the plug and socket, so that the assistant can make contact only while the engine is being turned over.

It is quite amusing, when at a regatta, to watch the different techniques of belt-pulling. Some exponents grip the boat between the knees and one assistant holds the other end, while others require two helpers holding the boat and devote their own efforts solely to rotating the engine.

There is no standard length of belt in favour—some are of enormous length and others so short that it seem difficult to get a good grip, ¼-in. dia. round leather is the most popular type of belt in use.

Engines with high compression ratios may be rather difficult to turn over, as the belt may tend to slip instead of turning the engine. Crossing the belt helps to eliminate this slip, and I have also found that a toggle handle on one end of the belt is a great advantage.

The old starting method of winding a cord or belt round and round the flywheel or pulley is hardly ever seen nowadays, although once very popular. It has the advantage of positively turning the engine when the cord is pulled, and is still used for full-size outboard motors.

The disadvantage is that with certain engines, the winding on process is time-consuming.

Built-in starting devices have never really caught on, although technically sound. Mr. E. T. Westbury's design incorporated within the flywheel, as described some years ago in THE MODEL ENGINEER has proved very successful, and can be recommended for those who wish to go in for something more elaborate than a length of leather belting.

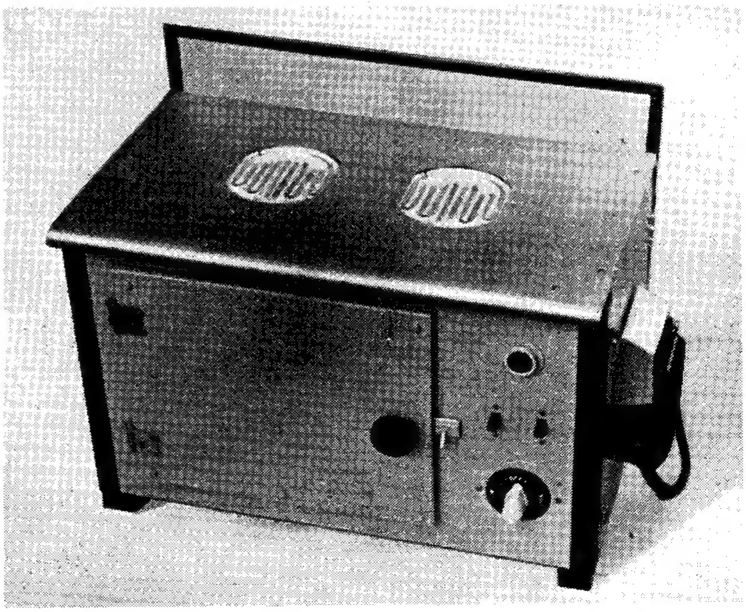
The beginner to competition work, especially where racing boats are concerned, is well advised to practise starting at the pondside, until the right methods have been perfected. It is quite useless to do this at home on the bench, or even in the open, as conditions at the lakeside are very different and practice will help to avoid that common remark, " That's funny—it started all right at home ! "

A HOME-MADE ELECTRIC COOKER

BEING in need of a suitable present for my sister, who did not wish to wait several months for an electric cooker, I devoted my model making skill and a fortnight's spare evenings to making my own. Her culinary joy and my satisfied palate testify to its success.

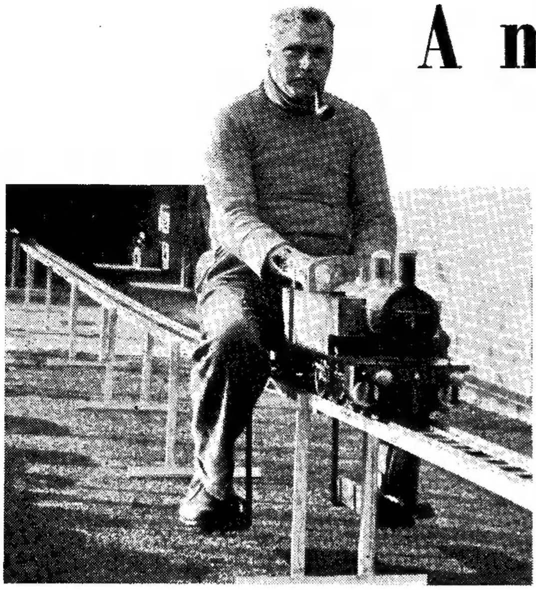
The oven is heated by two 500-watt fire elements controlled by a three-position switch fed from a double-pole main switch and fuse unit via a neon indicator lamp. The top rings are 750 watt each and controlled by separate switches.

The framework is of 1¼ in. angle iron solidly bolted together and the panels are of 18-gauge black iron. The oven is lagged with slag wool, and the whole finished in grey with a black edging. Dimensions 24 in. × 16 in. × 13 in.—W.H.



A multi-gauge portable track

By J. M. Ball



The society's Vice-President testing the track

IT is the dream and ambition of every "live" models society to have a railway track of its "very own," and our society is no exception to the rule, and so, after one or two meetings of "steam men," during which gallons of the "engineman's best friend" were consumed together with many ounces of tobacco, a plan was drawn up.

As a result of our (The North Staffs Models Society) bitter experience with a permanent track, which was almost totally destroyed by hooligans before the war, a multi-gauge portable track was decided on. Now, as we are a "model" society, what could possibly be more correct than to make a model of the proposed track first ?

This was done, the model was passed round at the next meeting and was declared "just what we need." It was decided that the main structure should be built of $1\frac{1}{4}$ in. × $1\frac{1}{4}$ in. × $\frac{1}{4}$ in. angle-iron and should consist of twenty sections each 6 ft. in length, the three most important features to be :—

(1) Portability ;
(2) Ease of storage ;
(3) Simple and straightforward erection.

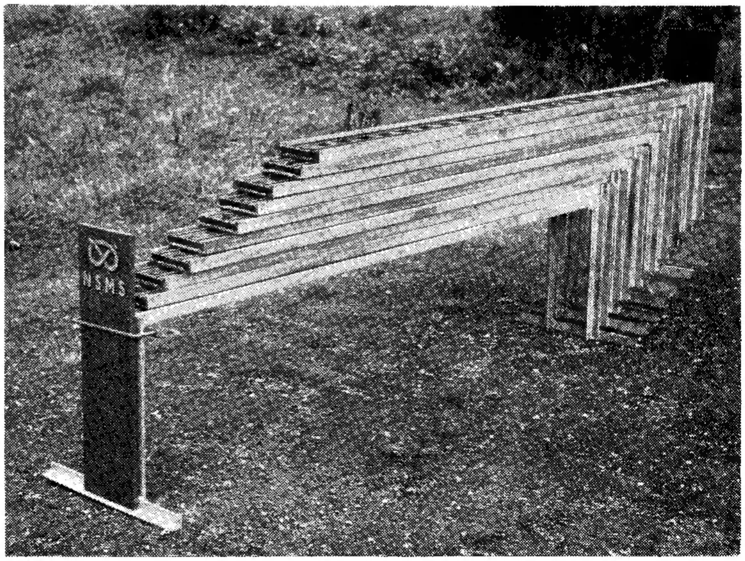
As will be seen by the photographs, only one section, which we call the "master section," has legs at *both* ends, all the other sections have legs at one end only, the other legless ends simply sit on and are bolted to their neighbours by one $\frac{3}{8}$-in. bolt and nut, which is accurately fitted to ensure correct and permanent alignment of the sections. The "master" length has a fixed buffer at one end, and a loose or portable buffer, bolted to the "last" length, completes the track at any multiple of 6 ft. up to its maximum of 120 ft.

Now, a word about the trials and travels of the track during its construction. Any other society contemplating a similar job would be well advised to "cultivate" the interest of some kind soul who owns a power hacksaw. Show him an engine—show him two engines—show him all your engines—but get the use of that power saw somehow. We did, and with its help, plus accurate marking-out, no snags at all were encountered.

The cutting-up was done in Stoke-on-Trent, a friendly motorist then carted all the bits to Cheadle, where another F.M. carted them to Stafford. Here they entered the workshop of a very well-known person in the model railway world. The said person, who must surely have been born with an electric welder in his fingers, stuck them together—the bits, of course, not his fingers.

The completed sections, after fitting and drilling, were sprayed with aluminium paint, and yet another F.M. carted them back to Stoke-on-Trent. Sleepers were cut and brought from Cheadle by motor-cycle. They were creosoted and fitted into the angle-iron sections, and brass flat-bottomed rails were then screwed to the sleepers by the usual method of r.h. screws and washers. It will be noted that the sleepers rest *inside* the angles which form the 5 in. gauge rails, on which all cars, driving and passenger, run ; the brass rails only take the weight of the engines. This, we hope, will make "platelaying" a

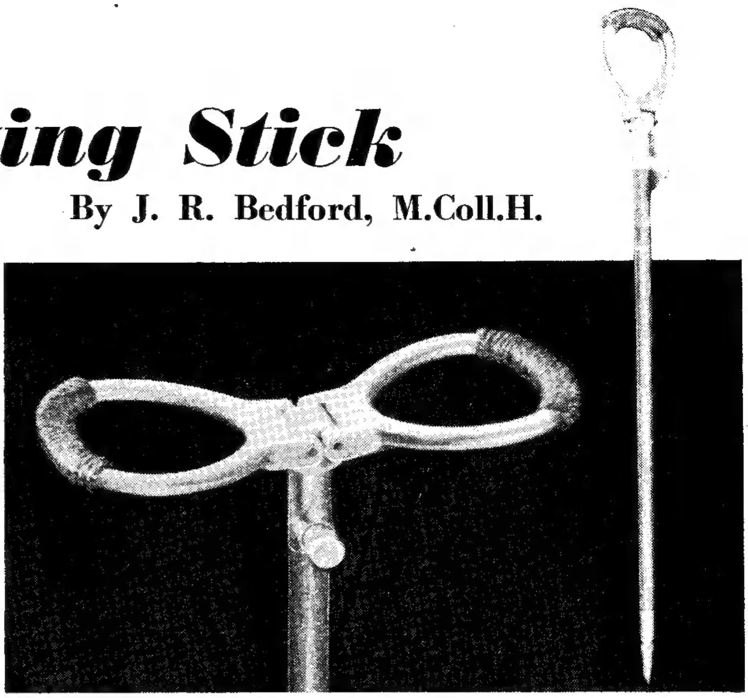
(*Continued on page* 354)



Showing ten lengths of track stacked

Making a *Shooting Stick*

By J. R. Bedford, M.Coll.H.



Photograph No. 1. *The completed stick. A close-up view of handle opened out is shown on left*

THOUGH at first view this work may not appear to fall within the sphere of model engineering it will be found on close examination that it gives opportunities for quite a varied amount of interesting machine work, whilst those who are not so well placed to do the machining will find that, with the exception of the bores in the head and the spike, and by omitting the disc, the entire work can be done using hand tools only. Alternatively, if one can persuade a friend to bore out the disc on the small side, it can be press-fitted to the spike. If the disc is to be made detachable as in the drawings, then a lathe will be needed.

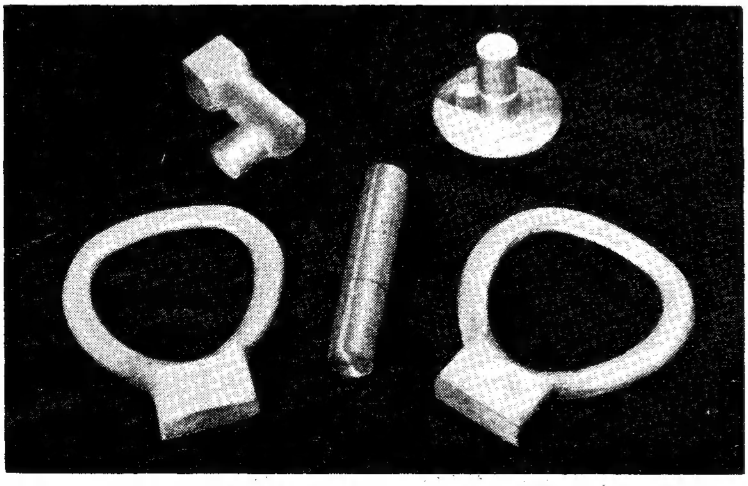
It was after a long and tiring day at an outdoor event that a mention of the perennial shortage of seats at these affairs brought forward the suggestion that I ought to make my own, and here is the result. Already it has earned for itself a place in the hierarchy of my faithful old friends and the imminence of old age is rendered far less disturbing with the prospect of this stalwart friend to lean on.

Nominal sizes are given for the patterns (Fig. 1). In practice these should be increased by $\frac{1}{8}$ in. per ft. to allow for contraction in the castings. Or if one possesses a patternmaker's rule the readings can be taken direct from this. A slight amount of draft can be given to the body and the handle, though on these small castings it does not really matter.

The pattern for the body should be made from a good quality hardwood, close grained. This will allow of its being machined to shape in the lathe, thus giving a preliminary try-out for machining the casting later. The photograph of the castings (Photograph 2) gives a good impression of the shape of the finished patterns.

The disc pattern may be cut from $\frac{3}{16}$-in. plywood with the stem portion turned up from hardwood and glued on. Care should be taken to provide sufficient length to allow for mounting in the 3-jaw chuck later. The piece that carries the spring-loaded pin can next be cut out and glued in place. All the internal corners should then be filled in and rounded off neatly to give a clean lift from the mould. An easy way to do this is to run in some soft beeswax and mould it to shape by using a warm modelling tool. This tool can be made from a $\frac{3}{8}$-in. ball bearing soldered to the end of a length of wire. This will be found to produce just the right curve.

The pattern for the handle should be cut from $\frac{3}{8}$-in. plywood. A tip for easy working here is to cut the hole first, radius and smooth the internal edges, and then cut the outside to shape. The rectangular base of the handle will need building up with a piece of $\frac{1}{4}$-in. plywood. This should be worked down at the corners to run into the thickness of the handle. The patterns should then be smoothed over with very worn glasspaper, given two coats of varnish, smoothed down again with fine worn glasspaper. One drop of linseed oil on the glasspaper



Photograph No. 2. *The castings*

will help to produce a smoother finish. Give one more even coat of polish. Provided these patterns are properly made it should be easy to have them cast by one of the firms advertising in this journal.

Whilst awaiting the return of the patterns with the new castings, a start can be made on the spike (Fig. 2). A piece of 1 in. diameter duralumin bar 5 in. long is needed for this. Centre both ends with a slocombe centre drill. Place 1 in. inside the 3-jaw chuck and locate the other end in the tailstock centre. Bring down 3$\frac{3}{4}$ in. of the bar to $\frac{3}{4}$ in. diameter and set the top-slide over to rough turn the taper. Turn round in the chuck and bore the $\frac{3}{4}$-in. hole one inch deep. Clean over the top of the bar, reverse again and finish the taper as shown in photograph No. 3. With a suitable parting-off tool turn the groove. It so happened that when I came to this operation the only tool I had ready was an old boring bar that I had ground up to produce a $\frac{1}{4}$-in. groove inside a bore. Just for the fun of breaking the rules I mounted this at the rear of the work, put the lathe in reverse (having made quite sure that the chuck would not unscrew itself and drop on my precious slides) and presto ! The job was done.

Next, a 25 in. length of good quality 1 in. diameter ash is required. A broken broom handle will do (but don't break one deliberately, the boss might not appreciate it). All that this needs is turning down to a strong $\frac{3}{4}$ in. at each end to fit the spike and the body respectively. The centre portion can then be glass papered smooth, given a suitable stain and french polished.

By this time our castings should

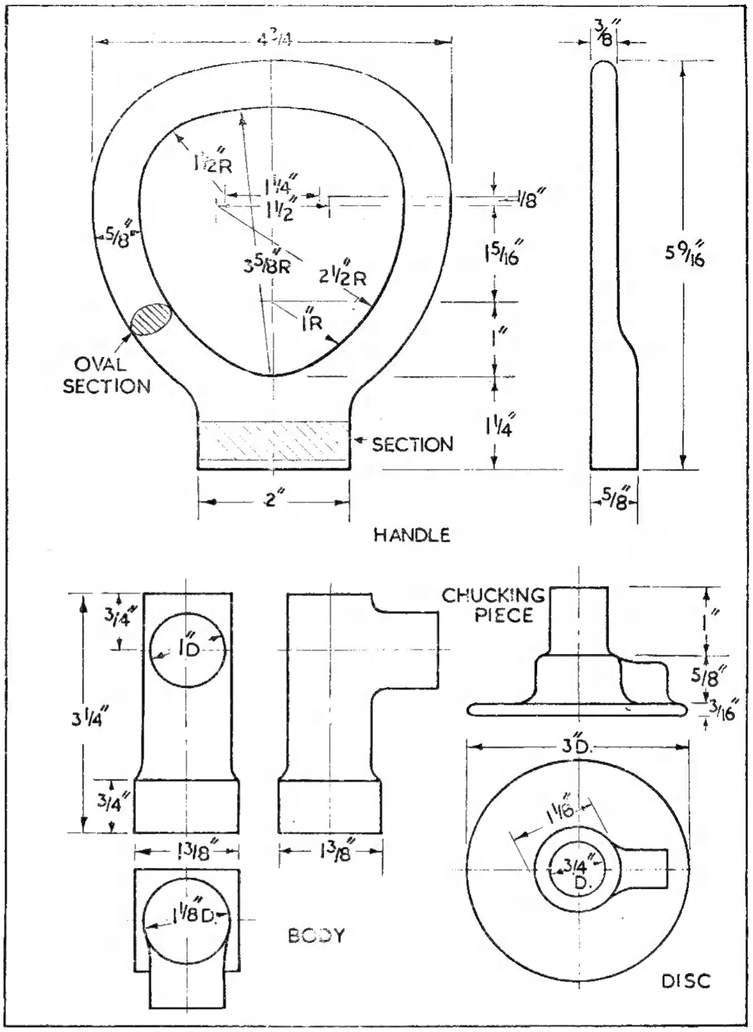
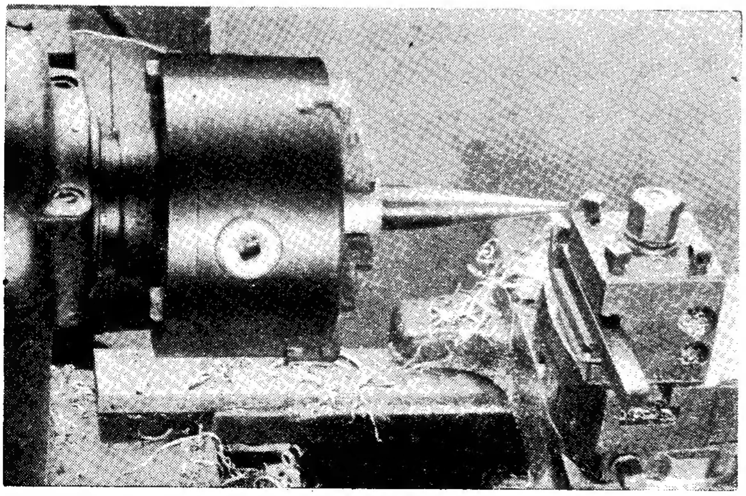


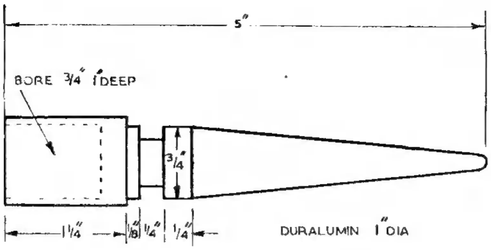
Fig. 1. The patterns

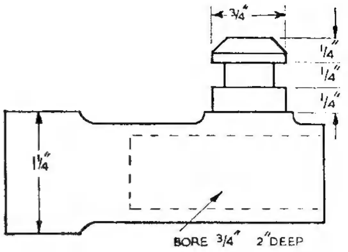


Left—Photograph No. 3. Finishing taper of spike

have arrived so a start can be made on the body. It is best to file the end square and true first. After which it can be clamped to the faceplate and the peg rough-turned as shown in photograph No. 4. The body should next be mounted by this peg in the 3-jaw chuck and one side of the square skimmed up. The remaining sides can then be turned up square and to size in the 4-jaw chuck. My chuck being a very small one, this necessitated the removal of one jaw to accommodate the length of the body (more broken rules). The body can then be held by the square head in the 4-jaw chuck and duly bored out. Care must be taken not to go beyond 2 in.

Fig. 2. Dimensional details of the spike. This is turned in the three-jaw chuck, supported at other end by the tailstock





deep. At the same time the outside of the barrel can be skimmed over to true up and save filing. The casting may next be mounted on the faceplate and the pin turned to finished size and shape, and the groove turned as shown in Photograph No. 5. Here again the left-hand grooving tool worked perfectly with the lathe in reverse. (A procedure guaranteed to give nightmares to the hypersensitive.) A set of lines should next be marked on the head inclined at 5 deg. to the two side faces. The body should then be mounted in the 4-jaw chuck and thrown over 5-deg. so that these scriber lines are square across the lathe. This can be checked by mounting a scribing block on the top-slide and then adjusting the curved end of the scriber to touch one end of the line. If the slide carrying the scribing block is then traversed across the bed, any inaccuracies in setting out will at once be seen and may be remedied accordingly. The waste portion can then be machined off. It would perhaps be as well to emphasise here that TWO opposite sides only are machined to a 5 deg. angle. This is to stop the handles slightly above horizontal. The other two sides are left square to fit the inside of the handles. The body can now be mounted on a plug in the 3-jaw chuck and the top of the head turned flat and true. The parts of the body not machined may now be filed up and polished.

The easiest way to tackle the handle is to clamp it to the faceplate and then clean up the face of the rectangular piece. The rough casting will probably need a little packing to level it out for a true cut. The slots can be marked out on this face taking the measurements direct from the body. A $\frac{3}{8}$-in. hole can be drilled and tapped through the centre of this waste piece and the handle reversed and secured to the faceplate by means of this screwed hole. The top face may now be skimmed over. It will be found easier to file and polish the handle now whilst there is still a robust pad to grip in the vice.

(*To be concluded*)

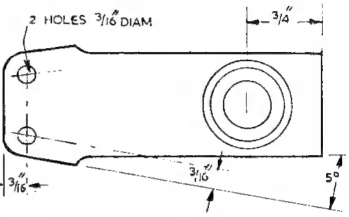
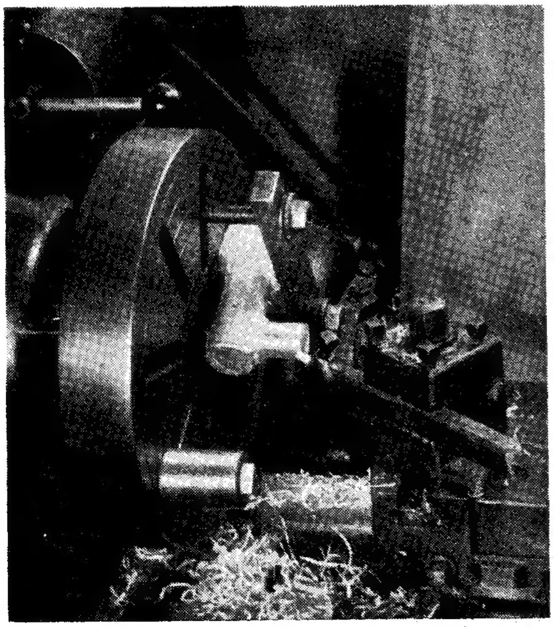
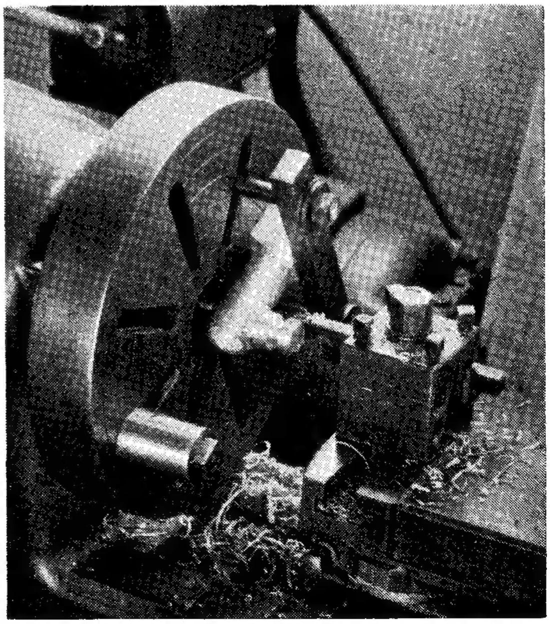


Fig. 3. Machining details of body



Photograph No. 4. Rough-turning peg of body



Photograph No. 5. Turning the groove in the pin

L.B.S.C.'s Lobby Chat

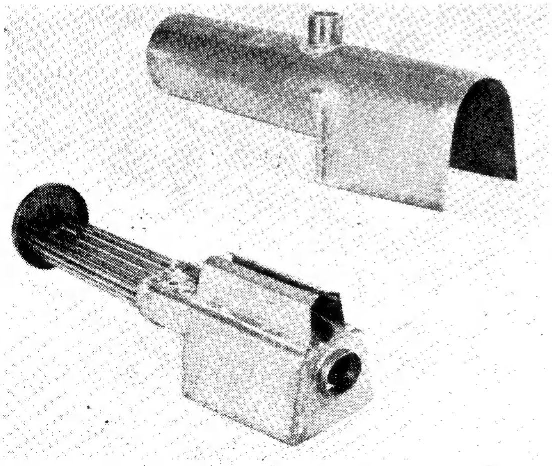
• SMALL LOCOMOTIVE BOILER JOINTS

DURING the last few days, time of writing, I have received several letters referring to joints in locomotive boilers ; so we might as well make that subject the basis for a lobby chat. First of all, I would like to state, for the benefit of new readers, that I have been building locomotive boilers for over half-a-century, which is a long time—in fact, long enough to provide sufficient experience to give a "guarantee" with all my boiler designs. The number of boilers that I have built, far exceeds those built by any other contributor to this journal ; probably more than all their combined efforts ! None of my boilers has failed, either in mechanical strength, or in steaming powers ; and those are plain statements of fact, neither ridiculous boasting, nor exaggeration. Curly may write ghost stories for your amusement, but doesn't tell "fairy tales" when it comes to doing a serious job of work, the failure of which might easily lead to consequences which would be serious indeed.

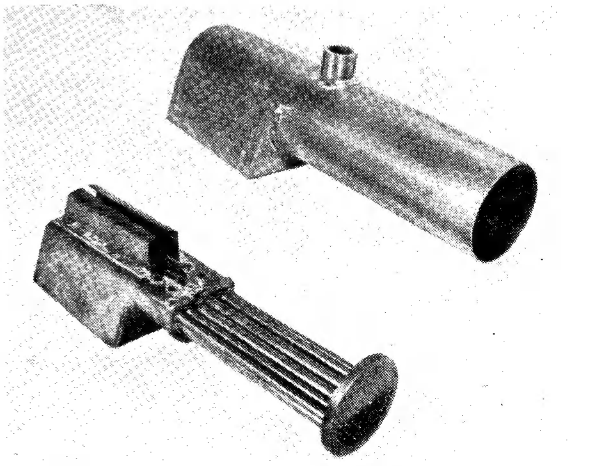
Let me preface my remarks with a true story which happened around the turn of the century, to a friend now, alas ! on the other side of Jordan. This friend bought an ancient single-wheeler locomotive, of the type I mentioned in a previous lobby chat, made by the old Macclesfield firm. It was in a dilapidated state, so he pulled it all down, and reconditioned it, without making any alteration to the design. The boiler was a piece of fairly thick brass tube, about $2\frac{1}{2}$ in. diameter, and the ends were plain discs, butted against the end of the barrel, and soldered all around. It was fired by four spirit wicks, the wick tubes being in a line equally spaced under the barrel. Now the end discs were larger in diameter than the actual barrel ; and as friend Wally was inclined, in some things, to be a relation of Inspector Meticulous, this didn't please him at all, and he decided to alter the boiler by making the ends flush with the barrel. Realising that this would destroy the solder fillet and reduce the strength of the boiler, he thought it would be a good wheeze to let the ends into the barrel, so he melted them off, and finding that the barrel was nearly $\frac{1}{16}$ in thick, conceived the idea of turning a little step in each end, and letting the discs into it. He had one of Holmes's seventeen-and-sixpenny lathes (eh ? No mistake at all ; you got half-a-crown change out of a sovereign !) with a 3 in. lever-scroll chuck, so it didn't take him long to rig up a wooden steady to hold the outer end of the barrel, whilst he turned a step in each end with a hand graver. Each disc was soldered to a bit of brass rod, just as I still specify for chucking smokebox doors made from brass blanks, and turned to a tight fit in the step. Wally soldered them in, and was as pleased as a dog with two tails at the im provement in the personal appearance of *Betsy*, as he called the engine, when he re-erected her.

Bang Goes "Betsy" !

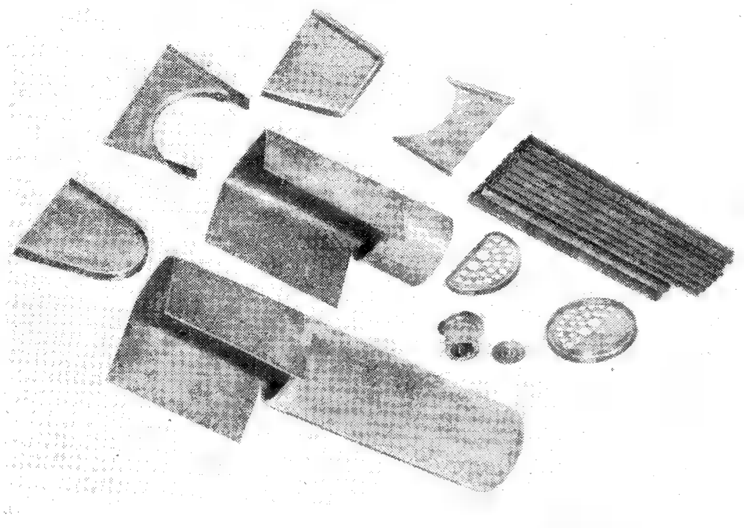
The house where Wally lived, formed one unit of an old-fashioned terrace, and had a glass-panelled front door, beyond which was a long passage leading to the kitchen ; so he made up a portable track with some tin rails soldered to tin sleepers, which, when laid on the linoleum, stretched right from the front door-mat to the back door of the kitchen, giving a quite respectable run. The *modus operandi* was for somebody to kneel on the floor at each end, and reverse the engine when it reached them. It always ran light ; these early efforts had quite enough job to pull their own weight, without any train ! Well, when Wally tested his rebuild, it was one night when his wife had gone to bed early, feeling tired after wash-day and



Note crown stays and firehole ring



Note throatplate and front end of combustion chamber



Parts of Mr. A. Milburn's Atlantic boiler—note flanged plates

shopping. Being all alone, he got up steam, and had to chase the engine up and down the passage to reverse it. He had the wicks up fairly high, and the engine was going grand, when—BANG ! Out went the front end of *Betsy's* boiler, clean through the glass panel of the front door with a tremendous crash ; the passage was filled with steam, and the rebound caused *Betsy* to somersault, upsetting the burning spirit all over the linoleum.

The bang and the crash woke up Mrs. Wally with a start ; she jumped out of bed and came running down the stairs in her nightdress, and seeing the cloud of steam and the flames, thought something awful had happened, and started screaming like nobody's business. The neighbours on both sides and across the road also heard the bang and the crash, followed by the screams, and came running out, thinking there was fire, or murder, or both, happening ; one of them blew a police whistle, and the woman next door, seeing the flames through the glass panel, and mistaking the steam for smoke, went and pulled the fire alarm, with the result that two policemen and the local fire engine came dashing up. It was a nice hullabaloo for a quiet respectable suburban street about 10 p.m. ! Meantime, Wally managed to beat out the burning spirit with the doormat, and the steam cleared off ; and it was a very redfaced and apologetic Wally who explained to the now sarcastic audience what had really happened. "Fancy your husband playing with a toy train just like some kid ! " said the woman next door to Mrs. Wally next morning.

Wally's Error

Wally told me all about it when I saw him soon after, and said that he couldn't understand why the end plate should have blown out, because in its original state, the boiler seemed sound enough. I told him that after he had stopped all sources of leakage, such as blowing pistons, glands, and valves, the engine didn't need the amount of steam it previously partly used and partly wasted, so that the pressure had risen, and the solder had lost strength under the increased heat. He said what would I suggest ; so I replied, turn the rebates a bit deeper, drive the ends in right to the shoulder, and then beat down the overhanging edge, flat on to the end. Do away with the test cock in the middle of the back end, and drill another hole in the middle of the front plate ; put a $\frac{3}{16}$-in. brass stay rod through, with a nut on the back end, and a pair of dummy smokebox handles screwed on to the front end, for sake of appearance, in place of a nut. Solder over the lot—flanges, nut, and handles. This was done, and there was no more trouble with the boiler ; but Mrs. Wally wouldn't let him run the locomotive indoors any more ! Wally's error was, of course, that his joints were not *mechanically* strong enough to resist the pressure, the solder having very little mechanical strength, and being merely a caulking medium to prevent leakage. Flanged and stayed as above, the boiler was O.K.

Playing for Safety

The commercial steam engines of my childhood had soldered boiler joints. You couldn't expect much for a shilling—or tenpence-halfpenny more often than not, as most shopkeepers in those days believed in small profits and quick returns. Toy steam engines advertised at the present time for two pounds and over, are pretty much of the same size and construction, as those mentioned above ! The vertical boilers had the sides and crown stamped in one piece, and the bottom soldered in. I made certain of a broken one that was given to me, by putting a ring under the bottom plate and riveting it in with domestic pins cut short. The horizontal boilers had ends with outside flanges, like the lids of coffee tins, but shallower, and they had a good solder fillet inside, as I found when I cut one open. On my own boilers, made from tin cans, or anything else handy, I always used lids for boiler ends, and put wire stays where I thought they were needed. My little contraptions always stood the pressure, and never let me down —or rather, never blew me up !

As I explained in previous childhood reminiscences, the first locomotives I built, had plain "pot" boilers, with a single row of spirit burners underneath ; and to make the ends quite safe, I riveted a ring, made from sheet metal, inside the barrel, a little way from each end, with brass boot-rivets. I could get plenty of those for a penny ! The end disc was butted up tightly against this, and the projecting bit of barrel hammered down flush on to it, the whole lot being soldered. These boilers were O.K. at 30 lb. pressure. I did the same with the front end of the Alexander boiler, and flanged out the ends of the fire-tube, so that it acted as a stay.

In Later Years

Memory of individual jobs grows dim with the passing of the years ; but when I built my first real loco-type boiler, I had no means of brazing it, and had to work the rivet-and-solder stunt. Naturally, it was impossible to butt two plates together and put rivets through, so the joints necessarily *had* to be flanged. Also, young Curly had the usual allocation of that precious commodity called common sense, and tried to utilise it. Common sense had taught me that if I soldered

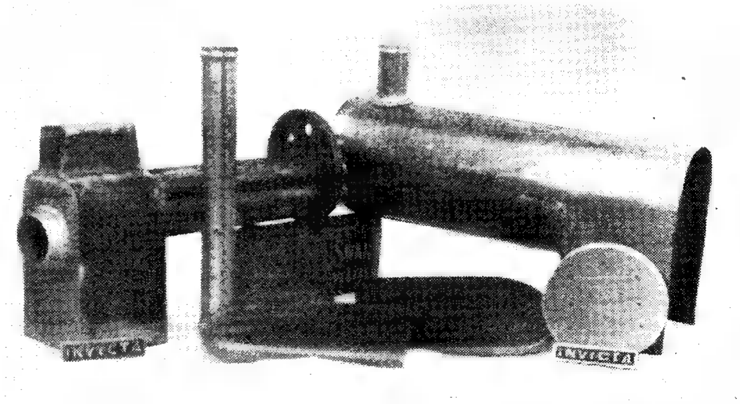
the lid on to a coffee-tin, and let the solder sweat through the full depth of the flanged part of the lid, it made a far stronger job than if I had simply butted a tin disc over the open end of the tin, and soldered around it ; a fact which isn't obvious to some folk, even at the present day ! When I read Alexander's book, and found that "Bro. Iron Wire" stressed that the firebox and flue of his locotype boilers should be brazed, to prevent any failure due to low water, I decided that mine should be brazed as well ; but our late brother said the job should be done by a coppersmith, and young Curly certainly wasn't having any of *that* ! I saved up and bought a one-pint "Etna" paraffin blowlamp, after starting work on the railway, and made friends with the coppersmith at the running sheds, who was a genial old craftsman, ready to help anybody who proved worthy of his teaching. He it was who showed me how to make a brazed joint in a copper firebox, and also initiated me into the mystery of the serrated joints by which the dome covers of the L.B. & S.C.Ry. engines were built up.

I soon got the knack of how to do a boiler brazing job, and incidentally learned it what one might call "the hard way," because I used brass wire, or granulated spelter, for such jobs as I did, including the firebox of the Alexander boiler. That worthy person never gave any instructions for making up the firebox, as his readers were supposed to enlist the aid of the coppersmith, as mentioned above; but common sense again taught me that copper sheet as thin as 21 gauge (the thickness specified) wouldn't give much 'hold,' even with a brass or spelter-brazed joint, if the plates were simply butted together, so I flanged them. I found that with careful heating, I could get the granulated spelter to run right through the joint, by judicious application of the flame, provided that the surfaces were clean, and well fluxed with powdered borax mixed with water. Anyway, to cut a long story short, when it came to building the boiler for *Ayesha*, I still only had the one-pint lamp, and managed to braze the firebox joints with it, and the superheater flue. The small tubes were screwed in with a fine thread; the outer joints of the boiler were flanged and riveted, and the lot sweated up with solder. The boiler stood the test pressure, and lasted many years. It was replaced when the soldered joints eventually cracked under the expansion and contraction stresses, and the foundation ring leaked badly. The new boiler, as I mentioned previously, was a Sifbronzed job, except for the silver-soldered tubes, and has never shed a tear from that day to this. I built a few more boilers, both with wide and narrow fireboxes, on the same general principle as *Ayesha's* viz.: brazed fireboxes, and rivet-and-solder "outsides," but I was never very happy about the ability of the solder caulking to stand up to the expansion and contraction stresses. Also, soft solder becomes plastic at high temperatures, and loses all its basic strength, as Wally discovered; and an example of this was given by a $2\frac{1}{2}$-in. gauge G.W.R. single-wheeler (*Lady of Narragansett*) which I built for a friend. He screwed the safety-valve down too tightly, and the steam pressure went up to something around 140 lb. at which point solder started to blow from both the backhead and throatplate joints. That was the deciding factor which made me switch over to all-brazed boilers. I did them with a five-pint blowlamp at first, and later acquired the "Alda" oxy-acetylene equipment which I still use. I also have two oxy-coal-gas blowpipes, which give a large diffused flame, and with careful adjustment of the gas and oxygen, can be used for silver-soldering without vaporising the metal and making a spongy joint. However, I prefer a paraffin blowlamp for silver-soldering tubes, and use a small home-made air-gas blowpipe for boiler fittings and similar "jewellery work."

Joint Strength

Now I have stated, and other folk have echoed, that a properly-brazed joint is as strong as, or even stronger, than the self-material. That IS so, but *the joint itself must also be right, before any attempt is made to braze it*; it would be precious little use putting half-a-dozen Yale locks on the door of a safe made from 26-gauge galvanised iron ! To be able to withstand the working pressure, all the joints of any boiler must be *mechanically sound*, as well as properly brazed. To that end, I always specify flanged joints in the boilers described in these notes, at all points where there is a great stress, viz. firebox end plates, smokebox tubeplate, backhead, and so forth. There is only one place where I find that a butt joint, without reinforcement, is permissible; and that is, between the throatplate and barrel of a round-topped boiler, like that on the *Lassie*. In such a joint, the tendency is for the pressure on the inside of the throatplate, to force it into close contact with the lower part of the end of the barrel; there is no tear-apart stress. Where a barrel is attached to a Belpaire firebox, some reinforcement is needed and for this I specify a "piston-ring" joint, placed inside. The brazing material not only fills the joint, but penetrates to the full width of the ring, and also forms a fillet around the outside, thus making a very strong and sound job.

When a flanged smokebox tubeplate is put in flange first, the brazing material will fill the space between the full depth of flange, and the barrel, and form a fillet around the outer edge, forming a joint that is indestructible by pressure. If it is put in with the flange outward, the flange being extended to carry the smokebox, there will be enough of the flange inside the barrel, to form a sound mechanical joint. If the end of the barrel is slightly bevelled, it helps the brazing material to flow in, and amalgamate with both flange and barrel; same applies



"Invicta" boiler under construction by Mr. S. Reeves—note flanged plates and girder stays

to the bevelled parts of a foundation ring. It is also necessary to have a good depth of flange around the backhead, to make a satisfactory joint with the wrapper, inasmuch as the large flat surface of the backhead exposed to steam pressure, puts a terrific strain on the joint. It is to take some of the stress off this joint, that I invariably specify the "Briggs" type of firehole ring, the edges of which are flanged outwards over the backhead and firebox door-plates.

If these joints are all *properly* brazed—and I mean just that—the boiler will be very strong and perfectly safe, given the usual type of staying. If the joints are *riveted*, as well as flanged, they will be self-supporting, and will be independent of anything (soft solder or otherwise) which may be used to "stop up the cracks" and prevent leakage.

Brazing Materials

Your humble servant's idea of a *properly brazed* joint, is one that is made with brass wire, granulated spelter, or an easy-running brazing strip with a high brass content. Doing a job with silver-solder is not strictly brazing, though some silver-solders, such as Johnson-Matthey's B6 alloy, will make a joint equal in strength to a brass-brazed one. Sifbronze is a kind of "super-brazing" material; joints made with this are practically surface-welded, and the material can be used with an oxy-acetylene blowpipe, without any risk of burning out or partly vaporising any of its contents, and rendering the residue brittle or spongy. I use it in all my boiler work—and as the S.I.F. Company's advertisements say, "Sifbronze is darn good stuff." I'll say it is! Brass wire can also be freely used with oxy-acetylene heating; but with easy-running strip, the intensity of the heat tends to "destroy its nature," in a manner of speaking, and renders the joint either brittle, spongy, or both. However, easy-running strip works fine with oxy-coal-gas heating, and of course is O.K. with a blowlamp or air-gas blowpipe. One of the best I ever used was of French origin, and called "Lafitte."

Pure silver-solder—that is, an alloy of silver and brass—will make a sound joint when used with an air-gas blowpipe, or a paraffin blowlamp. It melts at a dull red heat, and the exact temperature depends on the proportions of silver and brass. The more silver, the less heat is needed. *Silver solder should never be used with an oxy-acetylene flame,* and only skilled workers should use even oxy-coal-gas; too much heat just "boils up" the molten metal, and you get a spongy joint with little, if any, mechanical strength.

There is very little mechanical strength in the "ersatz" silver-solders, and the same applies to the "tectics." These are the materials which are self-fluxing. Joints made by them, even at low heats, are brittle; and "Silbralloy", for example, should never be used for any joints in a boiler, unless the said joints are mechanically able to stand the pressure required, without any aid from the material. It is intended by the makers, to be used for different purposes altogether, for which it is suitable. It *can* be used for stopping up the cracks, in the same way as ordinary soft solder; but even then, it needs a mild heat, such as a blowlamp or air-gas blowpipe. If subjected to intense heat, as provided by an oxy-acetylene or oxy-coal blowpipe, its nature is changed, and it becomes brittle, porous, and spongy. Same remarks apply to all other alloys of a like nature. A joint made by applying this material to it, by aid of an oxy-acetylene flame, is just the reverse to being "properly brazed"; even if the joints are flanged, they must be riveted as well. One correspondent tells me that he made up one of my boilers for a 2½-in. gauge Pacific, flanging all the plates exactly as specified, and "brazed" it with "Silbralloy." It simply split up on the hydraulic test. He scrapped it, started from scratch again, and used B6 and "Easyflo," as specified in my notes as an alternative to brass or Sifbronze. The boiler stood the test perfectly, and is still in use.

A multi-gauge portable track

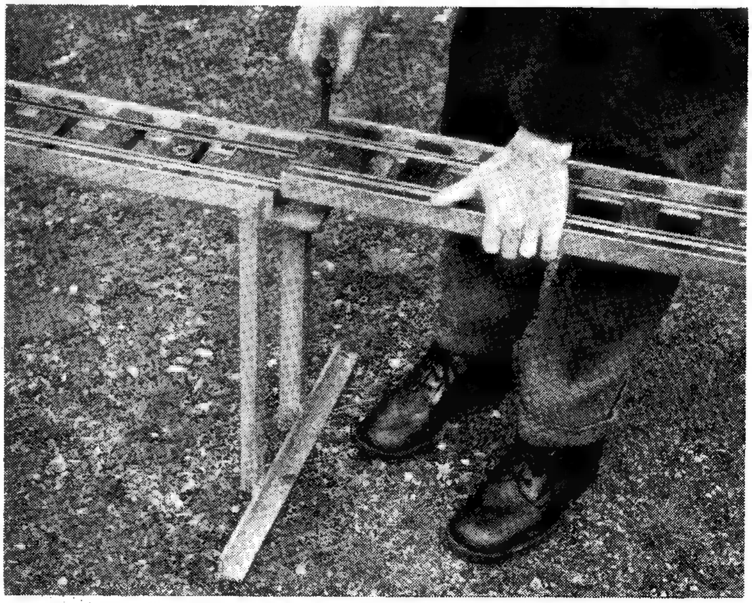
(*Continued from page* 347)

necessity only at long intervals. Four gauges are catered for—5 in., 3½ in., 2½ in. and 1¼ in.

Well, after many months, the track was completed and duly tested by our worthy vice-president (weight 16 stone) on a short wheel-base four-wheeled flat car and his new 5-in. gauge 0-6-0 tank engine. No appreciable deflection was noticed.

The official opening took place in the grounds of the society's head-quarters at Pitfield House, when, amidst much steam and the cheers of quite a few people who wondered if the boiler was going to burst, the first train started on its journey.

So far the track has exceeded all expectations. It is possible for one man to erect 60 ft. in ten minutes; when stored, the sections fit one upon the other like the kiddies interlocking building bricks.



Showing the one-bolt fixing method

READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

ROTARY-VALVE ENGINES

DEAR SIR,—Having read in the query columns of "Ours" that "J.H., of Bristol," is asking for particulars of rotary valve i.c. engines, perhaps I could help a little. In the *Motor* for December 13th, 1938, was a blueprint line drawing of three types of engines: the Aspin, Cross, and Cuddon-Fletcher. They are merely exploded views, and contain no dimensions, but would possibly assist J.H. in deciding which one to build.

Also, Hutchinson's Publications issued a book on rotary valve engines, the book being mentioned in "For the Bookshelf" in THE MODEL ENGINEER for June 19th, 1947. This would be of great assistance to your querist, as it contains descriptions of at least six different engines, all built on the same principle.

I trust this may prove of service to J.H., and if he cares to write to me, care of the "M.E.", I will gladly loan the drawing referred to above.

Yours faithfully,
Streatham. L. JONES.

DEAR SIR,—The query of J.H. (Bristol) interested me very much, as I have entertained an ambition to construct a model rotary valve i.c. engine for years.

The type I have in mind is the Darracq valveless "Sans Saupape" (C. Henriod's patent). The Darracq Co. introduced this simple type in 1911 and caused a sensation at Olympia by showing a 20 h.p. four-cylinder model with two showcases on the stand, one containing 100 poppet-valve parts of the 35-45 h.p. Darracq engine and other showing the two parts of the "valveless"—the rotor and silent chain. The valveless engine was not a success as a motor car engine, as it had poor flexibility, and we changed a great number over to the Clegg poppet-valve engine.

However, I believe the valveless engines did very well as motor boat power plants. At certain engine speeds they were quite silent and vibrationless.

Perhaps with modern heat-resisting materials a more successful engine of this type could now be built, but at that time the makers found it necessary to mask the port with the piston to prevent the full heat of the explosion damaging the cast-iron rotor, with consequent loss of efficiency from incomplete scavenging of the exhaust.

Yours faithfully,
Middlesex. F. G. FENNER.

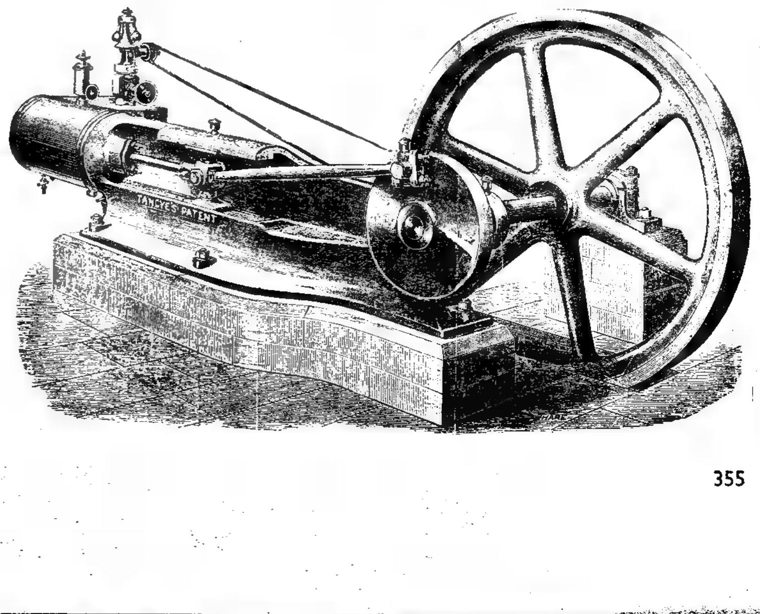
TANGYE STEAM ENGINES

DEAR SIR,—I notice in "Readers' Letters" in THE MODEL ENGINEER for January 29th, the further reference to the Tangye engine. As these are very fine prototypes for models, I enclose an engraving of a horizontal engine from the firm's 1868 catalogue, which gives sufficient details to make an authentic model.

All the engines illustrated, from the 2 n.h.p. at £28 to the 25 n.h.p. at £220, are of the same pattern, which appears to be an earlier version of that given in B.C.J.'s original article. Feed pumps were supplied at a small extra cost and the cylinders were neatly covered in sheet-iron, but mahogany lagging with brass bands could be supplied as an extra. An expansion-valve on the main slide-valve could be fitted to the larger engines. Other illustrations show the engine fitted with a tail-rod to operate a double-acting water-pump or condenser air pump, mounted on the same base. For higher lifts or pressures the same type of d.a. pump was geared down to the engine, the cylinders being side by side, but the pump piston-rod ran in a guide with a forked connecting-rod. Two cylinder engines are also shown and those for winding engines have ordinary link motion.

I am surprised that Mr. K. N. Harris, in his letter, "M.E." Feb. 5th, did not mention Messrs. T. Bates & Co.'s launch engine with Joy valve-gear, fitted with *straight* slides, the sole instance, so far as I am aware, of straight slides for Joy valve-gear in full size practice. When "L.B.S.C." published his "Dairymaid" design, I made one to his specification with curved slides. After that, I made a 10-wheel tank engine with practically the same mechanism, but with longer connecting-rods and straight slides. The valve-gear was carefully proportioned in accordance with the instructions, contained in Mr. Joy's pamphlet. The timing was not at all bad and the engine ran well in both directions. Somehow, I did not like the straight slides, and when I built another inside cylinder-chassis, I went back to curved slides. Surely the answer to this question is that straight slides may be used with long connecting-rod engines, but curved slides should be fitted for short connecting-rods, which are usually found in inside-cylinder locomotives.

Yours faithfully,
Swanage. H. E. RENDALL.



HAND ENGRAVING

DEAR SIR,—Hidden away in a narrow and ancient alley near the Charterhouse is a small workshop where reproduction clocks are still made by hand by men who prove that the ability of our ancient craftsmen still exists. There, some while ago, I saw clock parts engraved with intricate and beautiful patterns. The opportunity to study the process clearly did not occur, but from that moment the urge was on me. Accordingly, I acquired some Swiss hand gravers, of a diamond shape, with the object of engraving the sides of a lantern clock. I had fondly imagined that a little practice would result in a fair copy of the original, a little thing by some fellow who went under the name of T. Tompion.

Although my tools must be much superior to those of Mr. Tompion, it is regrettable that their points show a distressing tendency to come off. When engraving curves the back edge of the tool damages the side of the groove, and whilst it is possible to "work" in the odd slip and make it form a part of the pattern, my ingenuity is a little strained when endeavouring to cope with a slip factor of 400 per cent.

If one examines the genuine article it is evident that each cut is made by a single unhesitating movement. No side wobble was necessary to ensure progression of the tool. The depth of cut is greater than I have been able to attain without damage to the edges.

How is it done? Will an expert provide us with an article? It would provide interesting reading.

Yours faithfully,
Hatfield. WALLACE BOLTON.

STEAM LAUNCH ENGINES

DEAR SIR,—I was more than gratified to read the letter from Mr. K. N. Harris in THE MODEL ENGINEER for February 5th. I found the praise from such an expert quite overwhelming, and am dealing with the points raised in the same order as written:

Savery's did make quite a range of compounds and triples. The smallest compound was listed as a 20 h.p. and a reader, Mr. Parsons, of Eastbourne, has written me to say that he has an unused specimen which he is going to install in a boat. The smallest triple was a 26 h.p. as stated, cylinders 3 in.-4¾ in. and 7 in. × 3½ in. stroke at 800 r.p.m. The valve gear was as stated, with the swing links shorter than the valve-rod, and I described it as a modified Joy gear. In an interesting letter from our Joy valve-gear expert, Mr. W. B. Hart, he informs me that it was an alternative provided for by David Joy himself. With regard to the method of fastening the crosshead pins, when writing the description I did not have the Savery drawings in front of me, but my own. The tapered screws on the original drawings are partially hollow, whereas in mine I have drilled right through as I did not use the same method of getting oil to the crosshead, but fitted the method described in the catalogue, which took the oil in through the front crosshead bolt, so I did not need to close up the end of the screws. I, too, thought the use of two valves for the L.P. unusual for such a small engine, although it was quite common in high-power naval machinery.

I was pleased to see the reference to Sissons engines being fitted with Francis Carr Marshall gear, which was news to me. The Marshall gear had been and gone before I served my apprenticeship at St. Peters Works, but a few Bucknall liners fitted with the gear came in for repairs whilst I was there, including the s.s. *Johannesburg*, *Bulawayo* and *Fort Salisbury*. Incidentally, F. C. Marshall gave a silver cup for competition amongst the apprentices, to be competed for each year; I won it two years.

The references to the Kingdon engines of Simpson Stricklands reminds me of the many hours I must have spent gazing in a merchant's shop window in Dean Street, Newcastle-on-Tyne, at a beautiful little Kingdon tandem quadruple. I believe it was the same engine that now rests in the Science Museum, South Kensington. I believe the four-crank quadruples Mr. Harris refers to were fitted with two sets of valve-gear only for the four cylinders, the H.P. and first I.P. on one crosshead and the second I.P. and L.P. on another crosshead.

What memories the writing of this letter has awakened!

Yours faithfully,
Hollinwood. A. W. G. TUCKER.

LATHE TOOLPOSTS

DEAR SIR,—When I opened the February 5th issue and saw the article by "Duplex" on toolholders, my faith in, and respect for, these able mechanics suffered something of a shock. I am aware that lathe makers cling to the Willis type toolholder, but surely the amateur making improvements to his lathe would wish to discard the obsolete?

Only a year or so ago I gave details of a suitable size of adjustable toolpost for the cross-slide of the M.L.7 and I imagine the alteration necessary for the Drummond "M" type lathe would have been slight. I have one of these toolposts for my cross-slide and another of the Norman pattern for the top-slide, and with either of these free it would be possible to mount *and* use half a dozen tools in the time taken to mount (let alone use) one in the Willis. I know the amateur is generally not tied for time, but what pleasure is to be derived from fiddling with bits of packing?

I should also like to criticise the method "Duplex" have adopted for mounting the Norman toolholder block. This requires the use of four fixing bolts when one central ½ in. or $\frac{9}{16}$ in. dia. bolt through the pillar would give a firmer fixing *and* allow the block to be used in either tee-slot, which is not possible with a plate straddling both slots. Incidentally, the usefulness of this block would be immeasurably increased by the fitting of a height adjusting-screw. Without this it must be very difficult to prevent the block rising or falling while the clamping-nut is being tightened.

Yours faithfully,
Croydon. L. A. WATSON.

SLIDE REST FOR DRILLING MACHINES

DEAR SIR,—I read with great interest the article on "A Compound Slide Rest for the Drill Press," and I could not agree more with Mr. A. E. Kerswell as to the usefulness of this attachment, and I am sure many of our readers, too. So how about it, "Duplex"? A fully descriptive article on the above for, say, a ½ in. capacity drill.

I feel sure some of our approved foundry men could do the needful, regarding castings.

Yours faithfully,
Teddington. C. H. BOND.

MODEL SAVERY LAUNCH ENGINE

DEAR SIR,—I read the article on Mr. Tucker's three-cylinder launch engine and I was sorry to find that the article did not go beyond a very good description and a plan and elevation of the engine.

The engine is such a fine example of model engineering that it made me wish there was a complete set of detail drawings and construction notes. I wonder if it would be possible for Mr. Tucker to contribute a complete article in THE MODEL ENGINEER; I think it would be appreciated by many steam enthusiasts.

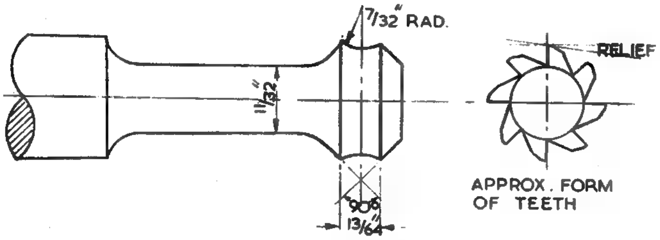
Yours faithfully,
Vancouver, B.C. P. M. CARTER.

The Allchin "M.E." Traction Engine to 1½ in. Scale

BY W. J. HUGHES

THE machining of the splines on the second shaft is an interesting operation, though it involves the need for some accurate setting-up. In my case, it involved a good deal of thought beforehand, in weighing up the pros and cons of various methods of doing the job, bearing in mind that it had to be done on a 3½-in. lathe. A milling-machine, shaper, or planer would probably have simplified matters, but in the first place the majority of my readers do not possess any of those desirable weapons, and secondly neither do I!

It was decided then, to make a special milling-cutter for the job; the shaft would be held on the vertical slide, and a 40-tooth change-wheel used to index the work.



Form of milling-cutter, and approximate form of teeth

The Form Milling-cutter

The milling-cutter was made from silver-steel of ⅝ in. diameter, though 9/16 in. would do, since the overall diameter of the teeth turned out to be 17/32 in. approximately. The sketch will show the form to which the blank should be turned, but first it is necessary to make a form lathe tool to turn the 7/32-in. radius groove in the cutter. The shape of this tool is shown in the next sketch. Mine was made by grinding the "back end" of an ordinary lathe tool to the radius required, but it could be specially made from a piece of square section silver-steel. (An ordinary tool may not be hard right through!) If you haven't a set of radius gauges, one of 7/32-in. radius may easily be made by drilling a 7/16 in. hole in a bit of bar—say, 1 in. × ⅛ in. section—and cutting it away as shown. Grind the tool as near as possible, and finish it off with an oil slip to the exact shape. Note that the tool has *no* top rake, because this would affect the radius.

When finishing, mark the centre-line on the tool, and see that this lines up with the centre-line of the radius-gauge.

Now grip the round silver-steel in the chuck, and rough it out to shape. An ordinary round-nosed tool may be used to turn the 7/32-in. radius as near as possible, with careful manipulation of the slide-rest handles—it is desirable to leave as little work as possible for the form tool to do, since it has no top rake.

Use the form tool to finish the radius off, taking only the lightest of cuts. If it is keen, and cutting oil is used, there should be no chatter—if there is, look to the mandrel bearings and the lathe slides! The tool should be mounted exactly at right-angles to the lathe axis, by the way, and *exactly at centre height.*

When the radius is formed, smear the blank with marking blue, and lightly scribe the centre-line round it by holding a scriber to the centre-line marked on the form tool.

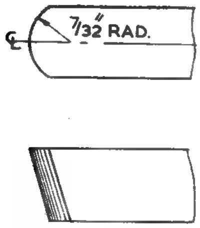
The 45-deg. shoulders on the cutter blank may now be turned off, using left-hand and right-hand tool successively at that angle to the lathe axis. The width of the concave part is 13/64 in., which will leave the splines of the shaft a few thous. thicker than ⅛ in. The shoulders should be equidistant from the marked centre-line, of course, and each should be the same diameter as the other, by micrometer test.

Forming the Teeth

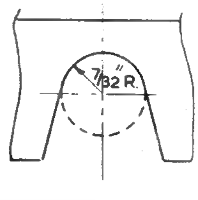
The teeth of the cutter could be filed up, or milled—in fact, they'll have to be finished by filing—but mine were done initially by "planing" them with a tool held in the top-slide, the saddle being racked back and forth. The shape of the tool was as sketched, and its cutting point must be exactly at centre height. Do not advance the tool more than 2 thou. for each cut, and cut all the teeth to the same depth, measured by the "mike" collar on the cross-slide screw.

It is not important to space the teeth *exactly* equally round the cutter, but they should be as near as you can judge, indexing the work by first having No. 1 chuck jaw at the top vertically, then bringing it forward at 45 deg., then horizontally, and so on "round the clock." This will leave the teeth looking somewhat as (*a*) in the next sketch. Before removing the tool from the chuck, you should centre-pop it against No. 1 jaw, so that it can go back in the same position.

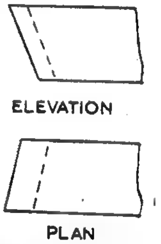
A slight relief (about 5 deg.) must now be given to the teeth, and this



Form tool for turning cutter

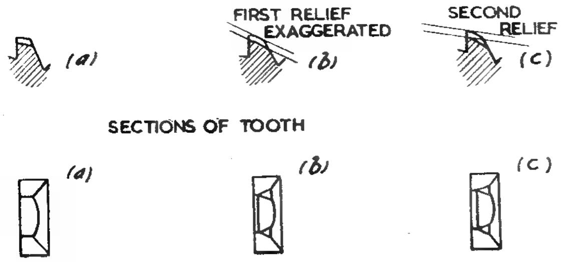


Easily made radius gauge

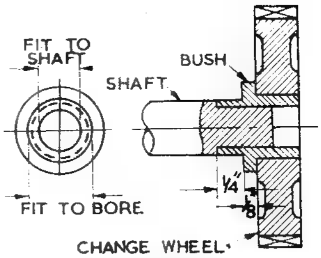


Shape of tool for "planing" teeth

Continued from page 245, February 19, 1953.



(*a*), (*b*) *and* (*c*), *Successive stages in forming teeth of cutter*



Bush for mounting wheel on shaft

is a delicate operation, especially with respect to the concave part, since ■ small " land " must be left at the cutting edge, as in (*b*). The relief may be filed with ■ small half-round file, though I did mine with ■ small grinding-pencil held in the chuck of the Wolf hand-drill, the latter being mounted in its bench-stand.

Next, relieve the tips of the teeth, also ■ in (*b*), still leaving very small lands at their extreme tips. Heat the business end of the tool to cherry red, and quench in lukewarm water. Polish the shank and the end with emery-cloth, and reheat the shank to a blue heat. Watch the band of colours travelling towards the tip of the tool, and when medium straw reaches it, quench again. In each case when quenching, plunge the tool *vertically* into the water.

Finally, with oil slips, give the lands you left a slight relief, of about 2 deg., and the tool is ready for action. The teeth should now appear as in (*c*).

Indexing the Shaft

In order to index the shaft and the broach, while the splining is being done, ■ 40-tooth change-wheel is required to be mounted on each in turn : for this purpose, a bush should be made to the dimensions shown, turned from ■ piece of brass bar. The interior hole should be bored to a tight fit on the end of the shaft, and the diameter of the outer shoulder should be an equally tight fit in the bore of the change-wheel, since it is essential that the latter does not slip, relative to the shaft. Incidentally, the bush shown in the drawing does not tally with that in the photographs ; it has been modified in the light of experience !

The bracket to hold the indexing screw may be made from a short end of brass or steel bar of suitable section—mine was $\frac{1}{2}$ in. by $\frac{5}{16}$ in. brass, and was clamped to the table by a single short tee-bolt. The screw, $\frac{3}{16}$ in. or $\frac{1}{4}$ in. dia., is turned on the end to a taper of about 60 deg., and a locknut is fitted behind the bracket.

Setting Up the Work

The photographs show pretty well my method of setting the shaft on the vertical slide. First, the vee-block was clamped to the surface, square with the edge, using faceplate dogs and tee-bolts. The shaft itself was held in the block by means of a clamp-bar and tee-bolts, and the projecting end was supported by an angle-bracket, to counteract the downward pressure of the milling-cutter. In my case, the bracket was simply a piece of $\frac{3}{4}$ in. by $\frac{5}{16}$ in. steel bar forged at right-angles—I made quite a number of these, years ago, for use as faceplate dogs.

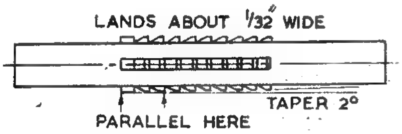
Chalk the four divisions on the change-wheel mounted on the shaft, and place the latter in the vee-block, tightening the clamp-nuts finger-tight. Screw the indexing-screw forward to engage with one of the marked teeth, if necessary slightly rotating the shaft to line up the two exactly.

Withdraw the screw slightly, and tighten the clamp-nuts with ■ spanner, though excessive pressure is neither necessary nor desirable. See that sufficient space is left between the part to be splined and the vee-block to allow the cutter to complete its run.

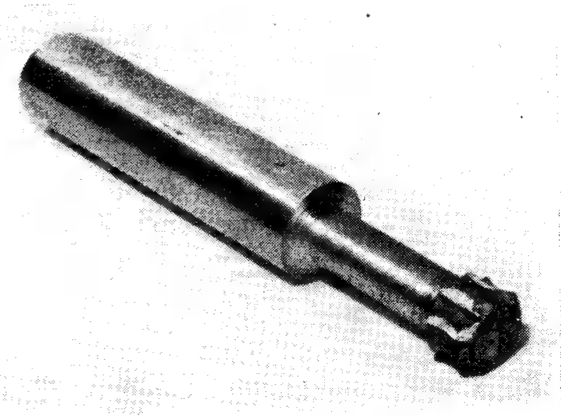
Now, from the *face* of the chuck, check carefully—*very* carefully !—to make sure that the shaft is exactly parallel with the face, and thus square with the axis of the lathe. This is done, as described in the last instalment, with inside calipers, from each end of the shaft, or rather the part to be splined.

Another careful check should be made, with the surface gauge, to see that the shaft is exactly parallel with the lathe bed.

Next, bring up the angle-support under the shaft, and tighten the nut securing it to the table. Check with



Teeth for broach



Right.—Photograph No. 25. Milling-cutter ready for hardening

the surface gauge again on the lathe bed, to make sure that this has not "sprung" the shaft upwards a shade. Now engage the indexing screw again with the gear-wheel, and tighten the locknut. Check again to see that the shaft is still parallel with the faceplate. If so, we're ready for the machining.

Milling the Splines

Insert the cutter in the chuck jaws, making sure that your centre-pop is against No. 1 jaw again.

Bring up the work under the tool, so that the centre-lin eof the shaft coincides with the centre of the cutter teeth. This can be checked in two ways: first, by eye, with the $\frac{7}{16}$ in. dia. of the shaft almost touching the concave part of the cutter, and a light behind it; secondly, with dividers you can check the distances between the centre of the teeth, and the centre-line of the shaft, from the chuck jaws, which distances should coincide.

Checking

As an additional check, take a trial run over the part to be splined, with the tool revolving and just touching the work. This should make two equal parallel marks all the way along, of course. By the way, don't forget that since the work lies under the tool, the cut should be started at the nearer end of the shaft, finishing at the far end, in order to take up any slack in the feedscrew. The slides should also be checked to ensure that there is no slackness in them.

Get Milling!

When you are satisfied that the work *is* central under the tool, lock the saddle in position, and start to mill in earnest. Run the lathe at its fastest, but don't be in too big a hurry to traverse the work. I took cuts of only 5 thous. at a time, since the work is not *too* well supported, and after each cut took another run down the work at the same reading of the vertical slide micrometer collar. Milling should stop when the cut just runs into the $\frac{7}{16}$-in. (plus 0.002 in.) diameter of the shaft: the total depth of cut can, of course, also be gauged by the aforesaid mike collar.

Having cut to the full depth, make a note of the final reading, slacken the nuts of the clamping bar, and turn the shaft through 90 deg., bringing the second of the chalk-marks on the 40-tooth wheel up to the indexing screw. It is not desirable to move the latter at any time.

Check again to see that the shaft is square across the lathe axis, with the calipers against the front face of the chuck, and then to see that it is still parallel with the lathe bed. Now repeat the milling operation, machining to exactly the same depth as before.

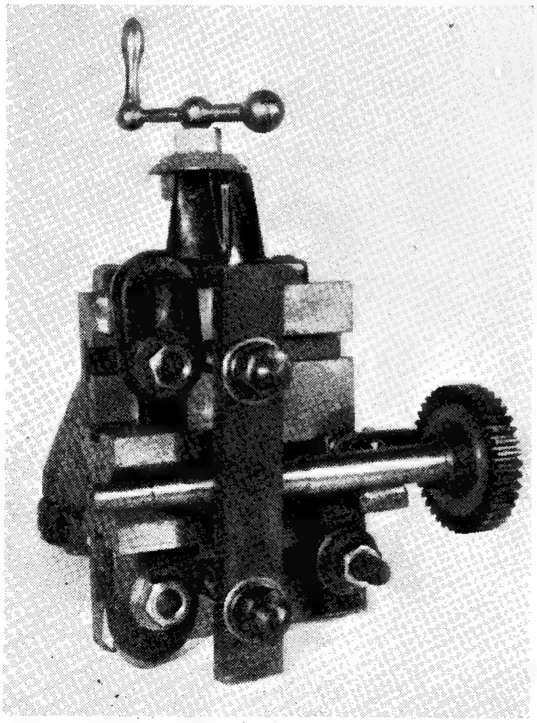
Further Operations

For the third and fourth machining operations, done likewise, it will be necessary to adjust upwards the position of the angle bracket supporting the splined end, because we have altered the effective diameter here. The shaft will only touch the bracket on the "corners" of the splines, and a piece of hard brass sheet may be interposed to protect these corners.

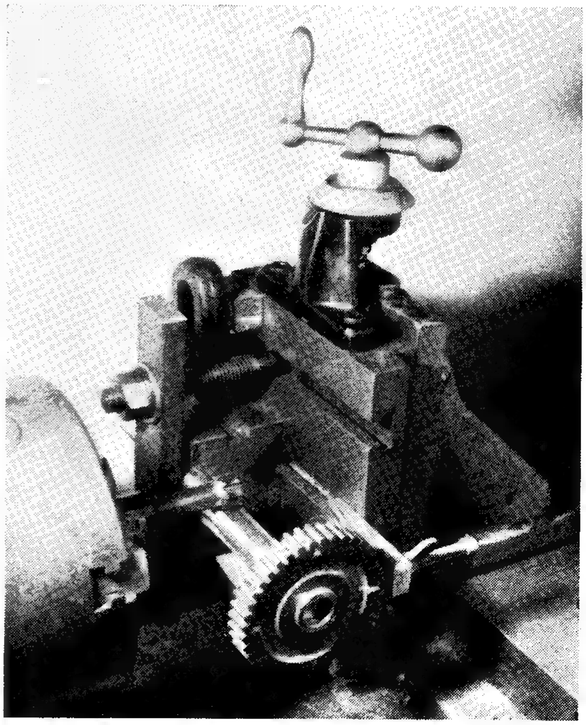
When the machining is complete, the diameters may be checked with calipers—most mikes will not get right down between the splines.

The silver-steel blank for the broach may now be machined up in exactly the same way as the shaft, following which both the shaft and the broach are turned between centres to correct diameter—$\frac{7}{16}$ in.—

(*Continued on page* 362)



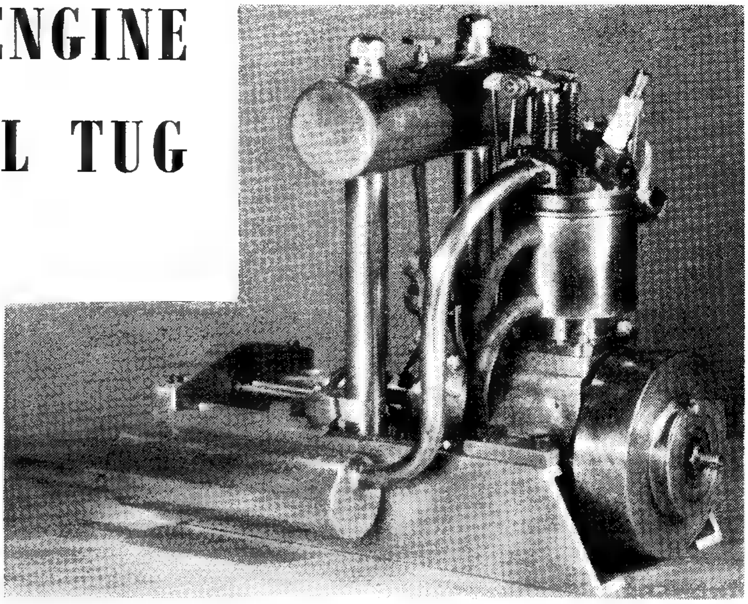
Photograph No. 26. Method of mounting shaft for milling splines. Note bracket supporting outer end



Photograph No. 27. Finishing the last cut on the splines. Note method of indexing

A PETROL ENGINE FOR A MODEL TUG

By F. J. Wood



FOR many years, my ambition to own a model tug has been very strong, so last winter work was started on the hull, which is 46 in. long with a 10 in. beam.

Having got as far as I could with the hull, the power plant received full attention. Before this could be started, however, I had to obtain a lathe, and after giving this matter much thought, the "E.W." was decided upon for sturdiness and cheapness. At the time, I was rather worried over the capacity of the lathe for the work in hand, a worry that was unfounded, as it proved quite adequate for all machining on the 15 c.c. engine, including cutting a cylinder from a 2 in. solid steel bar, and a flywheel from a 4 in. blank. Funds not running high enough to purchase two chucks, a 3 in., 4-jaw was purchased. Round stock gave me a few headaches at first, but after a few hours' work on the lathe, it came very easy, and now I am not very keen about owning a 3-jaw chuck, even if that "lucky line" comes up! As the photographs show, the engine is a 15 c.c. "Kiwi," designed by E. T. Westbury; there are a few alterations to the original design, the chief one being that it has been adapted to water-cooling. This engine was chosen, as it was considered to be a well tried design, having a good speed range. Drawings and castings are still available.

The machining of the engine did not present any difficulties, the "E.W." being quite large enough to cope with it. Some of the larger parts were machined as follows: The two crankcase halves were chucked, insides and spigots turned, and bearing housing holes bored. To machine the top of the crankcase for the cylinder seating, the two halves were bolted together and the whole lot attached to the faceplate by means of the crankcase mounting lugs. A piece of steel was passed through the bearing holes, protruding through either end for about an inch, and by this means I was able to measure the distance between the steel bar and the faceplate, and ensure that the cylinder seating was parallel with the crankshaft.

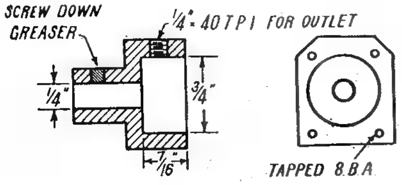
Being impatient to get on with the job, the cylinder was machined from a solid piece of 2-in. steel bar—all that was available at the time. This was chucked and bored to just under the inch; it was then transferred to a mandrel, and the outside turned. A flange was left at the top thick enough for the cylinder-head bolts, and another flange lower down to allow a water jacket to be sweated on. The cylinder was then clamped to a boring table, (supplied as an extra to the lathe, giving 1⅜ in. below centres) machine to 1 in. diameter with a boring bar, and finally lapped with a lead bar.

The flywheel was turned from a 4 in. diameter × 1¼ in. thick brass blank, as I did not wish to use any material likely to rust. This was machined in a normal manner, like the rest of the engine, which took about three months of my spare time to complete.

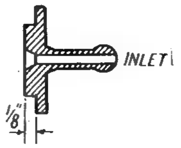
The Petrol Tank

This is a piece of brass tube with brazed-in ends; it is supported to the channel section dural engine mounts by two ⅝ in. diameter brass tubes which extend right through the tank. One of these tubes is used for the oil tank, at the bottom of which is a needle valve, to regulate the oil. The other tube is blanked off inside, in line with the bottom of the tank, and above this are three rectangular slots to allow the petrol to enter the tank. A needle valve is fitted to the centre of the tank. On the bottom of the two tubes, pieces of 16-gauge brass are brazed on to act as feet, and with these the whole assembly is bolted down.

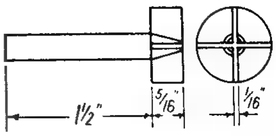
The water pump, driven at engine speed, was simplicity itself, and I consider very efficient. It took only



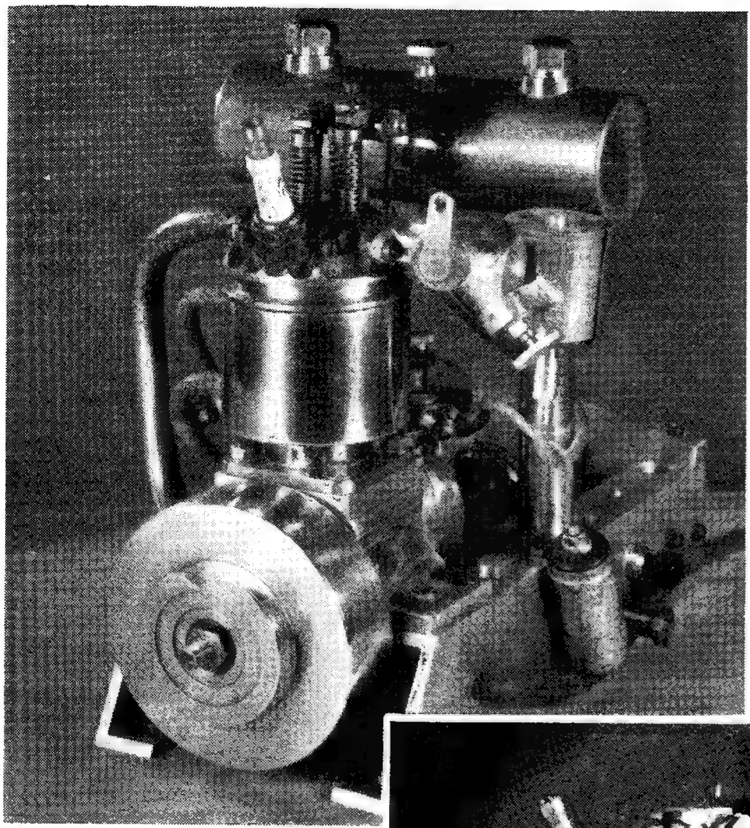
Main body



End cover



Impeller



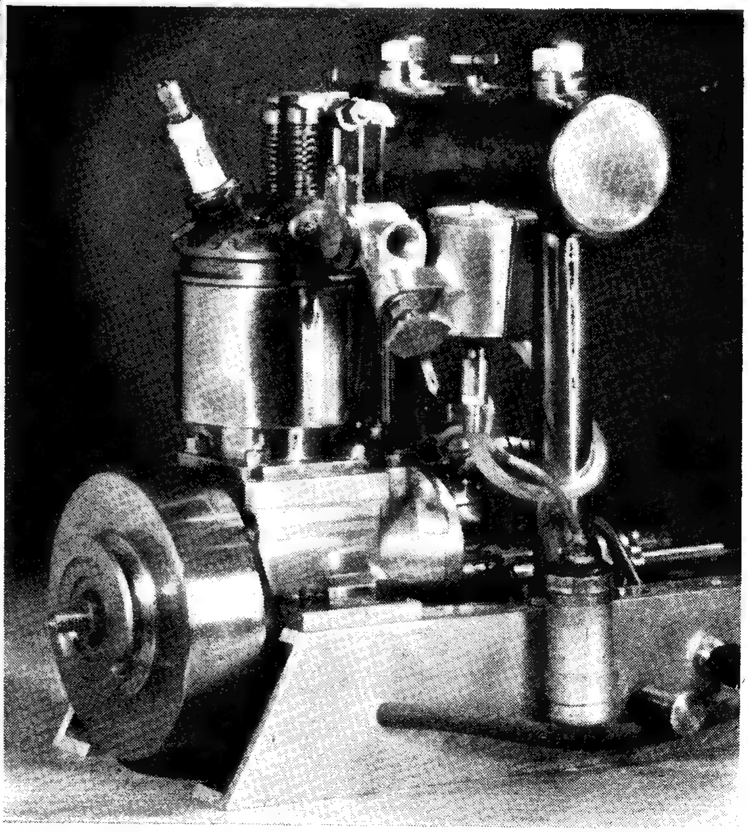
a few hours to complete. The main body was machined from a square piece of gunmetal; the drawing shows the necessary measurements. The inlet and outlet attachments are made for rubber hose. The impeller was machined from a piece of ¾-in. steel, the first 1½ in. being turned down to ¼ in. diameter, leaving a disc ¾ in. × $\frac{5}{16}$ in. on the end. This was drilled, sawn, and finally filed to leave four straight blades. Stainless-steel not being available, these blades were tinned with soft solder to prevent rusting. A screw-down greaser is fitted to the bearing. The pump delivers the correct amount of water to the cylinder jacket, and keeps the engine at a moderate temperature; it needs no priming, being fitted below the water line in the boat.

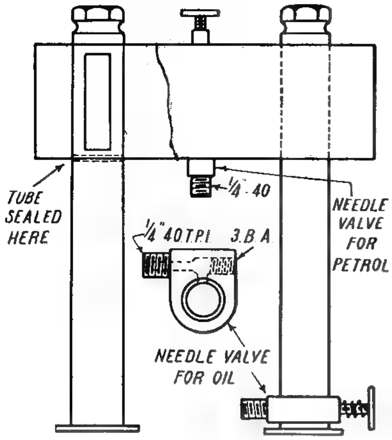
Testing

A small commercial magneto was purchased and the whole engine assembled ready for test. At last the great day had arrived—but had it? After several hours pulling at the cord, and several rechecks over the timing, not a sound was heard. Thinking that the magneto spark was not strong enough at such low revs., two second-hand small coils were borrowed and a contact breaker made for the engine, but still with negative results. With thoughts fast turning to steam, I asked the advice of an experienced friend, and was informed by him that the three components wouldn't start anything. Not having enough cash to purchase a new coil, an old scrapped motor-cycle magneto was brought into use. After removing the outer casing, the armature was temporarily wired up to the engine, and then I saw a spark—a real *cracker*. This was the day, two pulls and away she went.

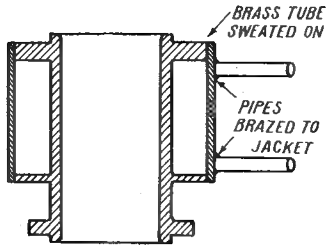
A Weighty Job

Weight being no object, a coil was made from the armature; the two end pieces and condenser were removed, and the coil put in the airing cupboard for a few days to remove all dampness. A small square ebonite box, fixed together with 8-B.A. screws, was made, the top having three holes drilled in to receive the three screws soldered to the coil wires. The coil was





Left—Petrol and oil tank



Section of cylinder

placed in the box, the whole lot filled with wax and the top quickly screwed into place, any excess wax escaping through the three screw holes. Nuts and washers were placed on the bolts and terminals made to attach the leads.

The engine on bench tests has been very satisfactory, and all parts have been assembled in the hull. A cone-type clutch, similar to one described in THE MODEL ENGINEER just prior to the war, is nearly completed; and by the time it is, I hope the weather will be kind enough to allow the first trials.

The photographs, including the one reproduced on the cover of this issue, were taken by E. W. Johnson, A.I.P.B.

THE ALLCHIN "M.E." TRACTION ENGINE

(*Continued from page* 359)

on the lengths not splined. And while the broach is between centres, you can also turn on it the teeth as shown in the drawing. The slight taper at the leading end should be turned first, of course.

Incidentally, the observant reader will note that my own broach, shown in the photograph, has a bigger taper on it. That is the result of too late hours in the workshop, coupled with thinking of something else at the same time! As it happens, no harm resulted, but the one as drawn will be better!

An Omission Rectified

I am sorry to say that when the photographs of Trevor Whitaker's Allchin bits and pieces were shown, in a recent issue, the name of the photographer was accidentally omitted. The pictures were taken by Mr. D. Harris, of the Whitchurch and District M.E.S., and I am grateful to him for allowing them to be published.

Incidentally, since the above was written, I have received from Mr. Whitaker the tools he used for making his splined shaft, and his broaches. These are all made from mild-steel, case-hardened, and have stood up to the job well. So if you haven't silver-steel in stock, you may care to do the same.

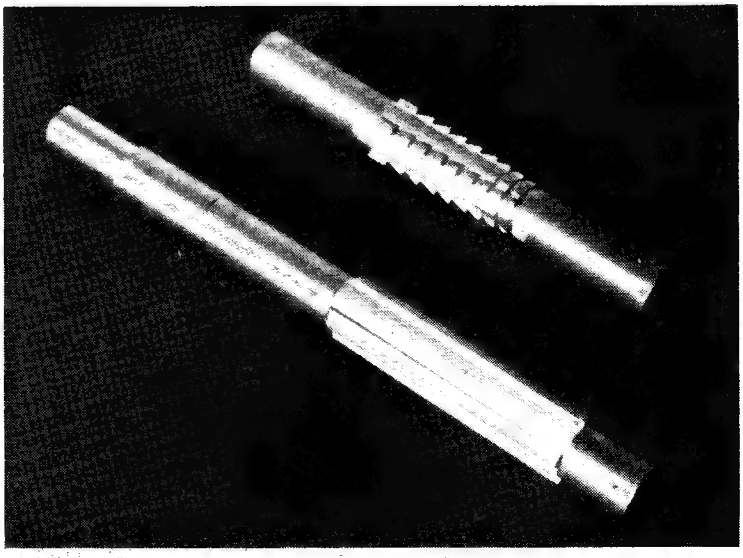
I will photograph these tools and publish the picture next time, all being well, since they differ somewhat from my own.

More Drawings Ready

At the time of writing, I have almost finished tracing the next sheet of drawings for our Allchin, so that by the time this article is published, the blueprint should be available from the "M.E." office—don't forget the new address!

The sheet includes general arrangement of the whole fore-carriage, and details of perch-bracket, turntable, fore-carriage fork, axle, spring and buckle, and spud-pan, etc. Details of the front wheels have had to be left for the next sheet, as there was not room on this one.

(*To be continued*)



Photograph No. 28. Completed splined shaft, and broach ready for hardening

Making square-ended socket spanners

By "Duplex"

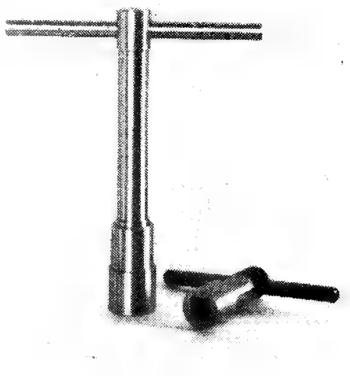


Fig. 1. Two $\frac{3}{8}$ in. square socket spanners

ALTHOUGH square-ended box spanners can be quite easily made by heating a length of steel tubing and hammering or pressing it over a square former of the appropriate size, something rather better than this is generally required where the tool serves as a key for use with a machine tool.

Solid wrenches of this kind, as listed in tool catalogues, have the square socket formed by a broaching operation ; that is to say, a hardened steel broach or drift is driven or pressed into the open end of the spanner, so as to convert a previously-drilled axial hole into a square-sided cavity.

Recently, it so happened that several square-ended keys were needed in the workshop, but those listed in catalogues had sockets 1/64 in. greater in diameter than the distance across the flats of the standard, square-ended fittings. As a better fit than this was needed, it was decided to make a special spanner for the square-ended clamping-screws of a tool turret, and another for operating the table-raising mechanism of a shaping machine. The two finished spanners are illustrated on the right and left respectively of Fig. 1.

The smaller spanner is obviously the neater job, as the socket end was kept short and brazed on to the shank, but as the larger tool was to be case-hardened, the end portion was pressed into place on the shank and then cross-pinned; anyhow, the method of making the socket end, which is the only difficult part of the work, is the same in either case.

The dimensions of the two $\frac{3}{8}$-in. spanners illustrated in Fig. 1 are given in Figs. 2 and 3.

The socket is made long enough to engage the full length of the square on the screw head or machine shaft, and also to afford a fixing for the shank. The diameter of the round steel used must be sufficient to allow the recess for the spanner shank to be drilled a little larger than the distance across the corners of the square. A short length of mild-steel rod is first faced at either end to bring it to the finished length, and a hole, equal in diameter to the distance across the flats of the square, is then drilled axially right through the part, as shown in Fig. 4 (*A*). The bore is now opened out at the top end with a boring tool, to fit on to the end of the spanner shank. The next operation, illustrated in Fig. 5, is to mark-out the square accurately on both ends of the work; for this purpose, an Offen V-block was found most convenient, as the sunk clamping plate allows the block to rest on all four sides on the surface plate. The scriber of the surface gauge is set to the periphery of the drilled bore, and in this way, the four sides of the square are marked-out.

To remove some of the surplus metal for bringing the square to shape, as shown in Fig. 4(*B*), a

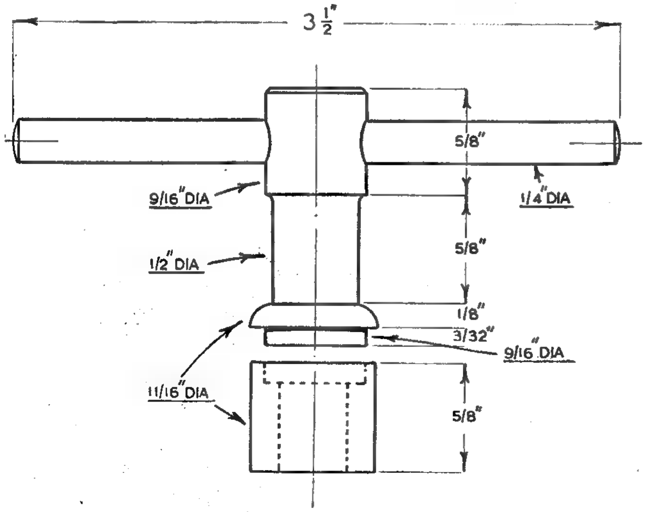
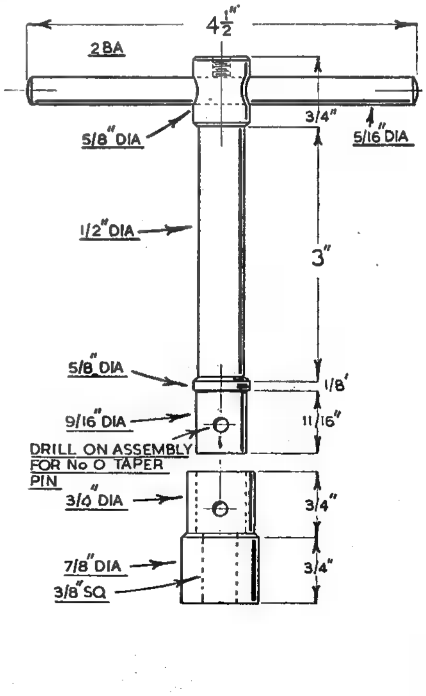


Fig. 2. Details of the smaller spanner with brazed joint



Right—Fig. 3. The shank of the larger spanner is secured with a taper pin

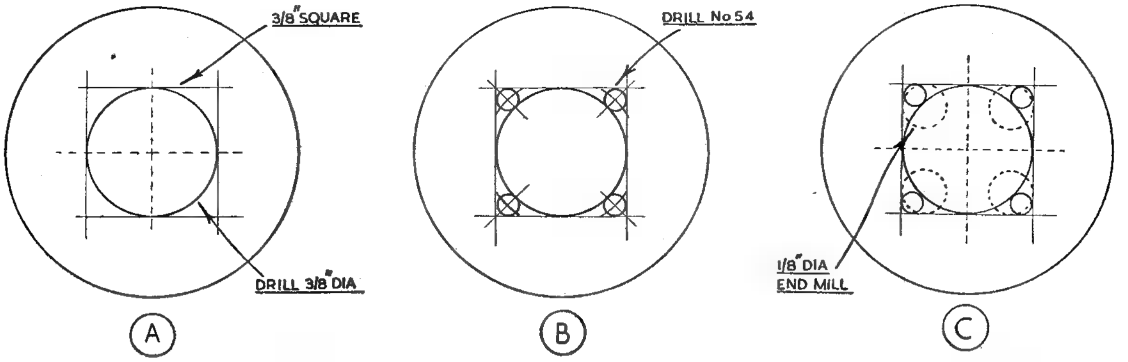


Fig. 4. Forming the square socket. " A "—Drill axially to the size of the square ; " B "—Drill out the corners of the square ; " C "—Remove more surplus metal with an end-mill

drill hole is put through at each of the four corners to meet the sides of the square.

To help those who dislike filing, more surplus metal can be removed towards the corners with a small end-mill, as shown in Fig. 4(*C*) This operation can be carried out with a $\frac{1}{8}$ in. diameter end-mill in the drilling machine; that is to say, if the machine itself is fitted for this kind of work. During the past ten years, the " M.E." drilling machine has been used for several small milling jobs, including cutting the ratchet teeth in a silver-steel blank. Good results and a fine finish have been obtained because, no doubt, the machine spindle and its bearings were carefully lapped to a close working fit. After all these years of use, the bearings are still in perfect order, and there seems to be no metal to metal contact at any point. An alloy steel spindle working directly in cast-iron would seem, here, to be better than fitting bronze bushes, for in a closely-fitted bearing of the former type, the oil film seems to be retained indefinitely, and seizure or scoring of the spindle is then hardly possible.

Bronze, on the other hand, is a less satisfactory metal to lap to a high finish, and a greater working clearance may be required ; in addition, constant lubrication must be maintained to avoid scoring and spindle wear, especially where the shaft is left unhardened.

To return to the milling operation, the V-block carrying the work is clamped to the drilling machine table and the mill is fed directly downwards so that the machining just meets the two adjacent sides of the square; this will leave very little metal to be removed by filing.

There seems to be a tendency nowadays with some workers to go to any length to avoid using hand tools and to rely, instead, on a machine to do the job. Surely, the right way to look at it is that one should first graduate on hand tools and master their use.

Starting with a fully-equipped machine, and then using hand tools only as a matter of necessity somehow seems the wrong way of going to work.

It may be as well, therefore, to describe the use of an extemporised jig for filing the flat sides of the square to the finished size. As shown in Fig. 6, a case-hardened toolmaker's clamp can be used or the vice itself will serve.

Mount the work in the clamp, with one of the scribed side-lines at either end of the part level with the surface of the jaws, and then grip the clamp in the bench vice. Select a worn file, as contact with the hardened steel will tend to blunt the teeth.

After filing until the file ceases to cut, reset the work in the clamp, and repeat the filing on the remaining sides of the square.

Next, try the socket on its square and, if it will not go on, paint the bore with marking fluid and tap lightly on to the square. The

(*Continued on page* 366)

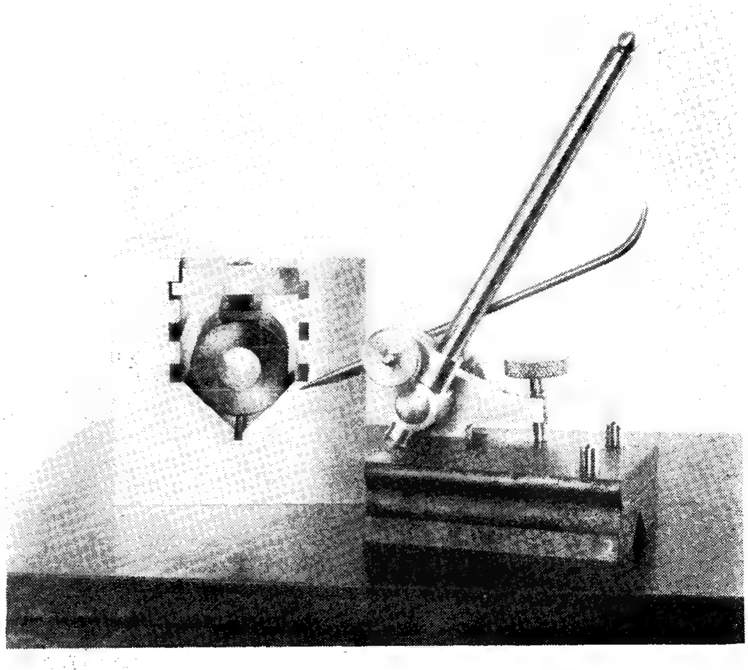


Fig. 5. Marking-out the square on the surface-plate

MODEL GREAT EASTERN LOCOMOTIVES

By A. S. Connor

THE recent interest shown in the pages of THE MODEL ENGINEER for the old G.E.R. Decapod tank locomotive and the article by Mr. Maskelyne regarding the delightful model of the G.E.R. 4-4-0 rebuilt T19, has prompted me, as a G.E.R. enthusiast, to pluck up courage and submit these photographs with brief descriptions of my three efforts, in the hope that they may be of interest, especially to those who remember the old Great Eastern in their heyday of royal blue and polished brass.

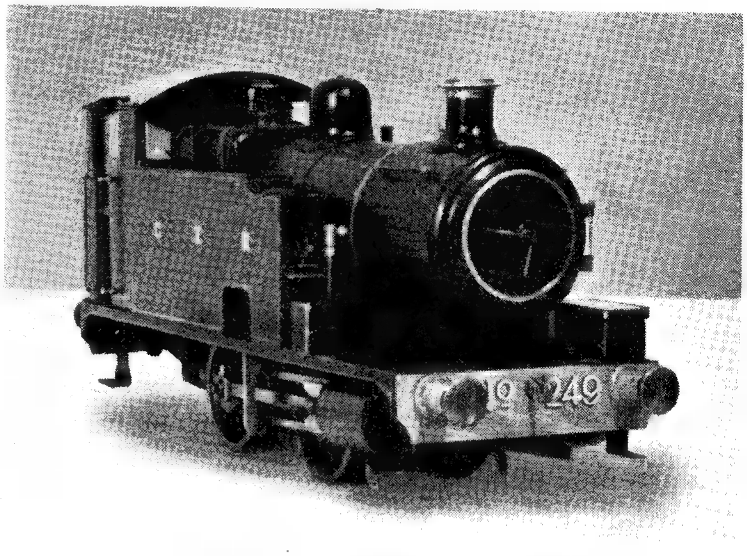
The *Petrolea* was built strictly to the "words and music" (with the exception of the outline of the tender) of our very good friend "L.B.S.C." during the time they were being published in THE MODEL ENGINEER. Its construction was often interrupted by the wailing of sirens (we had one outside our house on the other side of the road) but the enthusiasm of my son and myself was undaunted and we "pressed on regardless" until finished. I make no claims to being a good mechanic, but the instructions were followed carefully, and the fact that this locomotive is so efficient and fast is indeed a great tribute to its designer. I understand that several club track records are held by this design.

The 0-4-0 tank engine is a "Bitza" (bits o' this and bits o' that) the design being based on the Y4 class. What I wanted was plenty of power, simple design, quick to build, no tender, easy to handle, and the ability to negotiate the smallest permissible radius, should circumstances permit me to have a track of my own, which may be in a confined space.

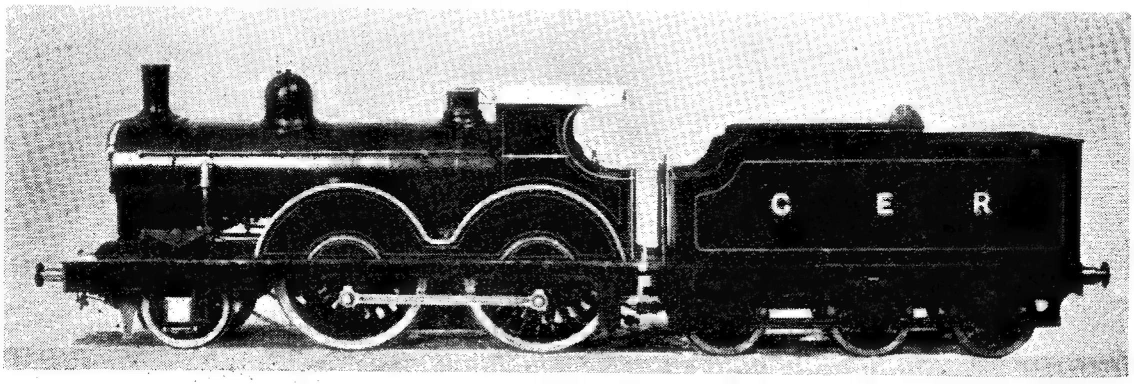
This idea coincided with the description of *Juliet*, and having visualised the outline, the next job was to sort out the existing "L.B.S.C." parts of other locomotives that would fill the need. To me this was very enjoyable, and the following was decided upon :

Frames—based on *Juliet.*
Wheels—*Iris.*
Cylinders—*Iris.* Mechanical lubricator.
Valve gear—*Juliet.* Slip eccentric.
Boiler—*P. V. Baker* (Belpaire dummy).
Water feed pump—*Hielan' Lassie.*

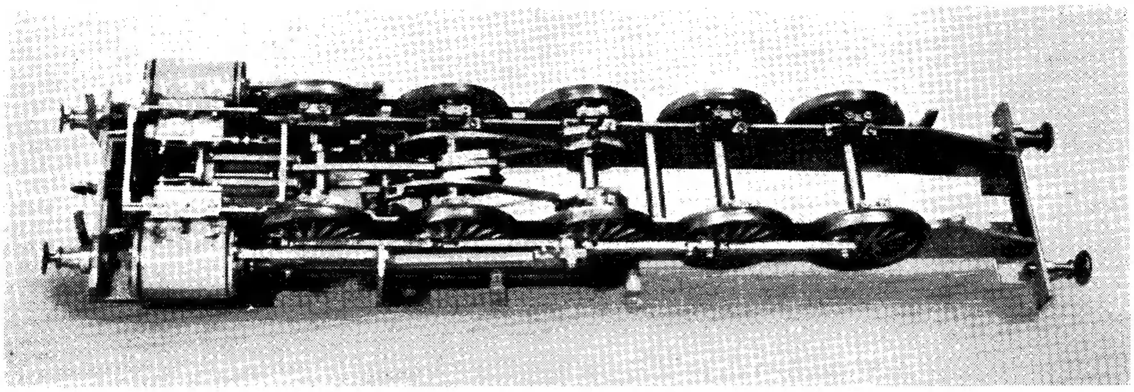
I was given the idea by a fellow club member, to try alloy pistons. He gave me an old diesel piston to melt down, which I did and the pistons were made accordingly. It was considered that the lighter material would be less strain on the motion at speed. The cylinders have not been opened up since 1949, and, in spite of the fact that this



Based on the G.E.R. "Y4" 0-4-0 tank—$3\frac{1}{2}$-in. gauge



Mr. Connor's "Petrolea"



Underside view of the G.E.R. 0-10-0 Decapod, showing trianguiated connecting-rod and cranked front axle

engine has been used quite a lot, they still continue to give very good service, without any suggestion of wear, and that is how they will remain—I hope! The blobs and gadgets, including smokebox, are from various types of G.E. locomotives.

In the club trials I have never got in the first three, but on the other hand I have always managed to stay the course and finish in good style—unaided, and with plenty of steam. Bearing in mind I have slip eccentrics, I am more than satisfied with this performance. However, on one occasion I tried her out to see exactly what could be pulled, a sort of maximum-pull effort. Five flat steel trucks with ball-bearings were loaded, and the combined weight, including myself, was 15 cwt.

I admit it was heavy going, and I did not attempt to go very far, but the fact remains that this weight was moved along the track unaided with very little wheel slip. I attribute this to the regulator which is of the dart variety, plus, of course, the very sound efficiency of anything in the small locomotive world which bears the hallmark "L.B.S.C."

My present effort is the famous G.E.R. 0-10-0 tank engine No. 20, "The Decapod," which has recently come into the news again. I am fortunate in being in possession of a G.E.R. G.A. blueprint dated 1902 from Stratford works, and what a work of art it is! The scale is $1\frac{1}{2}$ in. to 1 ft., therefore reducing to $\frac{3}{4}$ in. to 1 ft. is no trouble at all. I have naturally decided that everything again has to be in accordance with the "words and music"; also, I want to have a reasonably accurate reproduction of the inside arrangement with four slide bars, triangular-shaped connecting-rod, with the cranked front axle through it. Owing to shortage of space, I expect the inside piston-rod will be used for working the boiler feed pump. *Iris* cylinders are used again; this time the bore is $1\frac{5}{16}$ in., and the connecting- and eccentric-rods lengthened by 2 in. The valves are made of alloy in addition to the pistons, which I have no doubt will lighten the work of the valve gear.

In the original engine there was a common steam chest for the inside cylinder and one of the outside cylinders, one set of ports each end and the slide valves working back to back. There were three sets of Stephenson's valve-gear.

In addition to the above, I am making a $\frac{1}{2}$ in. scale or $2\frac{1}{2}$-in. gauge version of the G.E.R. single-driver No. 10. This, I may say, is one of the spare time "in between" jobs, and in the "due course" department awaits a "Claud Hamilton."

In conclusion, I would like to thank, and pay tribute to my son, D. S. Connor and Mr. G. Day, for their painstaking efforts in producing the photographs.

Square-Ended Socket Spanners

(*Continued from page* 364)

pressure marks will show where more filing is needed. Continue in this way until the socket can be pushed into place to engage the full length of the square.

After the shank has been centre-drilled at either end, it is turned to a light force-fit in the socket, where it is retained in place either by brazing or by means of a stout taper pin. At its upper end, the shank is cross-drilled reaming-size for the handle, and the top of the shank is also drilled and tapped 2 B.A. for an Allen set-screw. Ream the shank to allow the handle to slide freely and tighten the set-screw to secure the handle in the central position. In this way, when working in an awkward corner, the handle can be moved to one side to allow the spanner to turn.

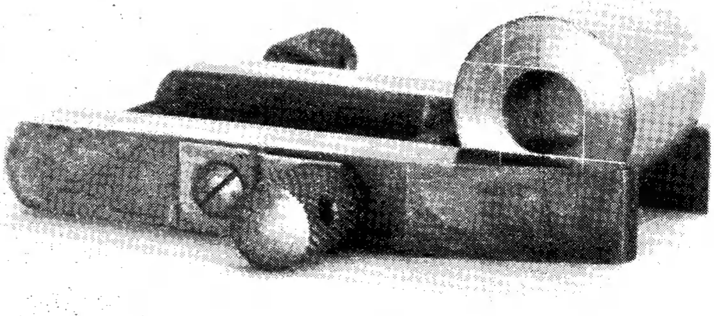


Fig. 6. A toolmaker's clamp used as a filing jig

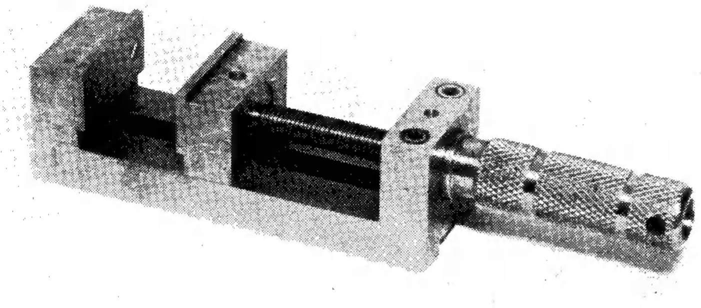
A SMALL MACHINE VICE

By D. Churm

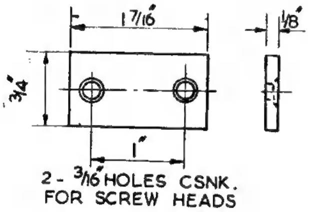
UPON the addition of a " Champion " ¼ in. drilling machine to the workshop, I soon found that a small machine vice was very badly needed for holding some jobs to drill accurately. I always think that no matter how large a capacity a vice has, you always come up against those jobs that are just a shade too big to hold, even after you have removed the detachable jaw plates, so on looking through various catalogues, and comparing different vices, I came to the conclusion that for the amount of room that some of them take, the holding capacity is very small indeed ; also, they are, in a lot of cases, too low in the height of the jaws. So, with these small points in mind, I have designed and made a vice around a piece of 1½ in. square mild-steel, which gives a capacity of 2¾ in. when fully open ; also, as can be seen, the overhang of the screw is inside the handle.

All the machining of this tool is very straightforward, and can all be done in the lathe. The first part to make is the body, which in my case was cold-rolled mild-steel.

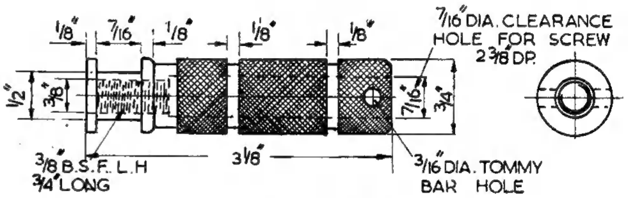
The first operation is to take a very light facing cut on all sides, not only to get it all square, but if you do not do this and proceed to carve out the metal on the one side only, you will find that it will not be flat, owing to the stresses which are always present in any steel which is cold-rolled (usually known as B.M.S., or bright mild-steel) ; these stresses can, of course, be relieved by heating up to a dull red and allowing to cool off slowly. The body-piece was then marked off, and the bulk of the metal was removed by drilling a series of holes, so that each one was just overlapping. It was then marked off on the bottom side for the jaw slot and keep-plate recess. After



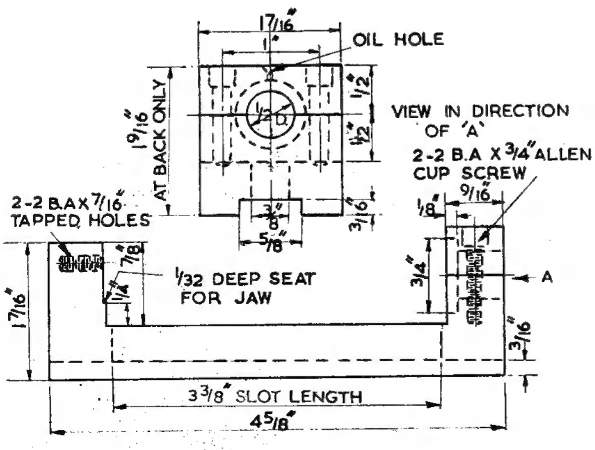
The finished tool ready for use



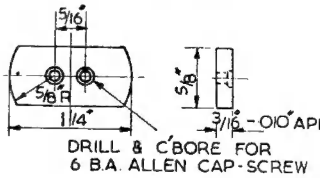
Jaw plate (2 off)



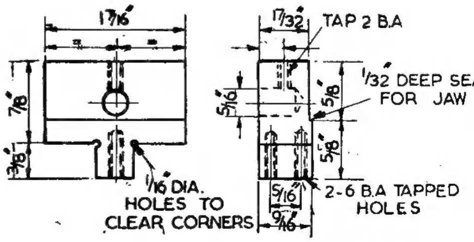
Handle—mild-steel



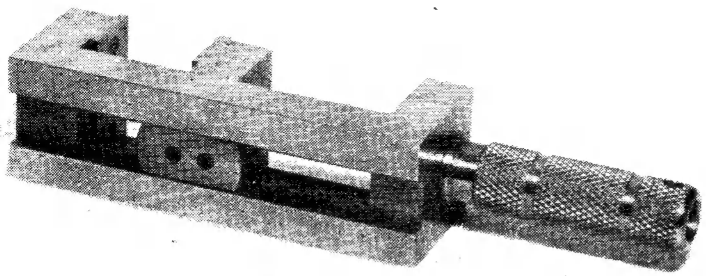
Vice body details—mild-steel



Keep-plate—mild-steel



Sliding jaw piece—mild-steel



setting it up on the cross-slide with a 0.001 clock, I drilled two holes, one at each end of the slot, and then with a $\frac{3}{8}$ in. dia. end-mill in the chuck, the slot was made while still set ; the $\frac{5}{8}$ in. wide recess was also done with a $\frac{5}{8}$ in. dia. end-mill. Afterwards, the inside was likewise end-milled, and $\frac{1}{2}$ in. removed off the top of the rear part, which has to be split, as can be seen in the drawing, to take the handle. When the removable block part which clamps in the handle was fitted, I left the hole and counterbore out until I had made the sliding jaw and fitted it in, so that I could then drill and bore the hole for the screw end to go in at the same setting that the boring and counter-boring was done on the end part of the vice body. The body was set up on an angleplate on the lathe faceplate for this.

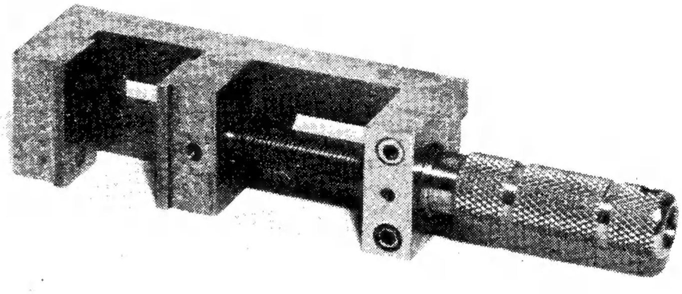
For this operation I made the sliding jaw a tight fit between the bottom of the vice, and the keep-plate, so that it would not slide about during the machining ; afterwards, it was bedded down with the aid of lapping paste. The more accurate you make and fit these parts, the less lapping in you will have to do ; otherwise, if your faces are not parallel and you get a good fit at one end of your vice, you will find that even 0.001 in. to 0.002 in. increase in thickness will wedge the jaw so hard that you will have some difficulty in freeing it. The keep-plate was also bedded in with lapping paste.

To remove high spots in the $\frac{5}{8}$ in. recess, I used a new carborundum stone block which I found was better than filing, as it leaves a nice finish to the faces. It is these little points which count so much to make a tool work nice and smooth, instead of being loose in one spot and tight in another.

The handle and screw are straightforward turning and screwcutting jobs. I used the removable clamping block as a gauge, so as to get a good fit between the shoulders of the handle.

The jaw plates, made out of a piece of gauge plate, were hardened, and afterwards I got them flat by rubbing them backwards and forwards on a broad carborundum stone. When hardening anything like these jaw plates, you will get very little distortion if, when heated, they are dropped in oil on their edge and not on the flat side. When the jaw plates are fixed in position, the height of the back of the vice is level with them, which is useful in case anytime the vice needs to be used upside down ; also, the sides are flush and square so that it can be used on its side, or even on its end, as that also is square to the base and sides.

Finally, I have given it a fairly good finish by the old method of using a piece of hard wood dowelling and metal polish in the drill to get the engine-turned effect, which I always think helps a great deal towards resisting that ever-present workshop worry, rust.



I intend to fit a baseplate on to the vice bottom as soon as a suitable piece of steel, such as gauge plate, can be obtained, as this, when left a little larger all round, will make it easy for clamping-down purposes.

FOR THE BOOKSHELF

Autocycles and Cyclemotors : How to get the best from them. By the Staff of *The Motor Cycle*. (London : Iliffe & Sons Ltd.) Size 7 in. × $4\frac{1}{4}$ in., 140 pages, 80 illustrations. Price 5s.

Within recent years, thousands of cyclists have been enabled to apply mechanical propulsion to their machines, and enjoy the advantages of completely or mainly effortless cycling. The idea of attaching a motor to a pedal cycle is by no means new—in fact, it is one of the oldest ideas in the history of motor transport—but its practical success has only been possible by the introduction of really small, light and well-balanced engines, having a high standard of reliability. Readers of this journal will hardly need to be reminded that much of the pioneer work in the development of such engines has been carried out in model engineering workshops, and the subject of the light " auxiliary " transport engine is therefore of more than ordinary interest to model engineers. In this useful and interesting handbook, every make of cycle motor at present available in this country is illustrated and described, and hints on their installation, maintenance, adjustment and repair. The autocycle, which may be described as a specially designed and complete machine, intermediate between the motor cycle and the pedal cycle, is similarly dealt with. Both technical and non-technical readers will find this little book excellent value for money.

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:
(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20 Noel Street, London, W.1.

Faulty Blowlamp

I recently made a blowlamp for a marine boiler, the burner being a coil of ¼-in. pipe round a ⅜ in. brass tube. On trying the lamp out with paraffin it proved a failure; when heated up, it developed a flame about a foot long which fluctuated and then went out in about two minutes. I have tried various pressures with the pump in tank, and different lengths of burner tube, but always with the same result. Can you suggest a remedy?

T.F. (Birmingham).

The fault is most probably in the nipple of the blowlamp, and we suspect that the diameter of the hole is too large. We would recommend you to fit one of the nipples used in Primus burners, which can be obtained from any of the advertisers supplying these stoves, or from a local ironmonger.

Locomotive Wheel Flanges

In reply to a recent query, you recommended that the flanges of the intermediate wheels of a 0-8-0 type engine for 5-in. gauge should be thinned. Is not this asking for trouble? Surely, the thin flanges would wear at a greater rate than those of normal thickness, and so need renewal in a shorter time. I think your querist would have been better advised to turn his intermediate wheels flat, without flanges. I did this with my 0-8-0 engine, which is for 3½-in. gauge, and she is still running with her original wheels.

J.F. (London, S.W.).

We do not think that the advice we gave in the instance you refer to would lead to trouble, provided, of course, that the flanges, normal or thinned, are the correct shape. The tread of the tyre should lead into the flange on a generous radius and then slope away from the rail-head. Flanges that have vertical faces next to the rail, tend to cause considerable friction when running on a sharp curve, even when the gauge of the track is slightly widened; but when the flange face is inclined away from the rail, as in full-size practice, the friction is greatly reduced. After all, this is one of the reasons why full-size flanges are shaped as they are.

Incidentally, we did suggest that out querist could remove the intermediate flanges. You do not say how long your own 0-8-0 has been "running with her original wheels," so your comment is meaningless; it would be just as true if the engine had been running for years, or only since yesterday!

An Optical Illusion

At a recent trade exhibition, I saw an exhibit in a small cabinet, which by means of some electrical device, was made to disappear gradually from view and in its place an "exploded" view of the object appeared. This sequence was carried on continuously at intervals of about one minute. Can you please explain how this illusion is produced?

H.B. (Coventry).

While we are not familiar with the exact mechanism of this device, and are therefore unable to answer your question in definite terms, there are several ways in which a similar effect could be obtained. The most probable appears to be the adaptation of a very old theatrical illusion known as "Pepper's Ghost," which depends on the reflecting properties of a sheet of plate glass inclined at a particular angle to the line of vision.

According to the illumination at the front or rear respectively, light can be either transmitted or reflected at will. In this way an object either directly behind the glass or in front of it, but at right angles to the line of vision, and screened from direct view, may be made to appear or disappear by suitable changes in the lighting arrangements.

This device has been extensively employed by stage illusionists and it would appear almost certain that the illusion you describe is some modification of this principle.